Dissertation on

A STUDY OF ULTRASOUND B SCAN FINDINGS IN ORBITAL DISORDERS AND CORRELATION WITH CT SCAN

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CERTIFICATE

This is to certify that the dissertation entitled, **"A STUDY OF ULTRASOUND B SCAN FINDINGS IN ORBITAL DISORDERS AND CORRELATION WITH CT SCAN"** submitted by **DR.A.SUDHAMATHY,** in partial fulfillment for the award of the degree of Master of Surgery in Ophthalmology by The Tamilnadu Dr.M.G.R.Medical University, Chennai is a bonafide record of the work done by her in the Regional Institute of Ophthalmology, Government Ophthalmic Hospital, Egmore, Chennai, during the academic year 2010-2012.

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PART-3

INTRODUCTION

Proptosis is defined as an abnormal protrusion of the eyeball. Proptosis can be the result of variety of disease processes including infections, inflammations, tumours, trauma, metastases, endocrine lesions, vascular disorders and extra orbital lesions.

Evaluation of proptosis include a detailed clinical history, ocular examination, laboratory investigations and imaging studies. Indications for ultrasound and CT scan are mostly limited to the study of orbital disorders in our study. In all cases, imaging is useful to characterize the precise location of the lesion, which can be intraconal space, or extraconal space of the eyeball, the features of the lesion and to precise the extent of the lesion.

These findings are used to generate a differential diagnosis to select the appropriate surgical approach and for follow up.

Ultrasound has become an extremely useful tool in assessment of orbital lesion since it is highly informative, non invasive and poses no risk to the patient, and so can be repeatedly performed in order to evaluate treatment effectiveness or disease progression.

In our study, we study the B scan findings and correlate them with CT scan results, which are more precise in terms of location, extent, size, nature of lesion and thereby assess the effectiveness of B Scan in arriving at the diagnosis of specific orbital lesion.

HISTORY:

Ultrasound was first used in ophthalmology in 1956 by 2 American ophthalmologists - Mundt and Hughes using time amplitude-mode (A-Scan)

In 1958, Baum and Greenwood developed first 2 dimensional (immersion) brightness-mode (B-Scan) ultrasound instrument.

In 1970, Coleman and associates-developed first commercially available immersion B scan instrument.

Bronson introduced a contact B-scan machine.

Ossoinig first used contact B scan instrument, known today as standardised echography.

PHYSICS:

Ultrasound is an acoustic wave consisting of oscillation of particles within a medium. Ultrasound waves have frequencies greater than 20 Khz (20,000 Oscillations/Sec), which are inaudible to human.

Ophthalmic Ultrasound frequencies range from 8 to 10 MHz (1 Megahertz = 1,000,000 cycles/sec), produce short wavelengths (less than 0.2 mm), allowing resolution of minute ocular and orbital structures.

Ultrasound is propagated as a longitudinal wave that consists of alternating compression and rarefaction of molecules as the wave passes through a medium.

Sound wave travels faster though a solid medium than through compressible liquid medium.

As a longitudinal wave travels through a tissue, part of the wave may be reflected back towards the source of emitted energy (i.e. transducers or probe) and this reflected wave is known as echo.

Echoes are produced by acoustic interfaces created at the junction of 2 media (Acoustic impedance = Sound velocity x density)

Stronger echo is produced when bordered by aqueous than when it is bordered by blood (hyphema)

Returning echoes are affected by many factors, including absorption and refraction, angle of sound incidence, size, shape and smoothness of acoustic interface.

Angle of sound incidence:

When incident beam strikes an interface in a perpendicular manner, the echo reflected back is stronger than an oblique beam.

Acoustic interfaces:

Retinal surface has a mirror like reflection; ciliary body has irregular, coarse surface . So, part of the echo will be scattered.

Absorption:

Ultrasound energy is gradually absorbed and converted to heat. Higher sound velocities and greater tissue thickness result in greater absorption of sound wave.

Refraction:

Refraction occurs when a sound beam is directed obliquely to an interface. No refraction occurs when a sound beam is directed perpendicular to an interface.

Pulse-echo system:

It is the production of multiple short pulses of ultrasound energy with a brief interval between pulses. The interval allows returning echoes to be detected, processed and displayed.

Generation of ultrasound waves:

Ultrasound waves are produced by a piezoelectric material. The tip of transducer (i.e.) probe emits pulses of ultrasound waves (i.e., sound beam) and receives the returning echoes. The detected echoes are processed and displayed on screen as echogram.

A-scan:

A-scan is a one dimensional acoustic display in which echoes are represented as vertical spikes from baseline. Height of displayed spikes indicates the strength (i.e.) the amplitude of the echoes.

A-scan uses 8 MHz transducer that emits a parallel sound beam.

B - Scan:

B-scan produces a two dimensional acoustic section by using vertical and horizontal dimension of the screen to indicate configuration and location.

- Frequency of 10 Mhz is used to examine low intensity scatters such as vitreous humor

  20 MHz probe provides superior resolution of posterior pole and orbit

- Echo is represented as a dot on screen rather than as spike
- Strength of echo is indicated by brightness of dots.
- Coalescence of multiple dots on screen form a 2 dimensional representation of examined tissue section

Indications for orbital ultrasonography:

Signs and symptoms: -

- Unilateral or bilateral exophthalmos or globe displacement
- Enophthalmos
- Lid abnormalities-lid retraction, lid lag, edema, ptosis, echymosis

- Palpable mass
- Chemosis
- Motility disturbances, diplopia
- Chorodial folds, disc edema, optic atrophy
- Pain, defective vision

Additional indications:

- Tissue differentiation of mass lesion
- Classification of CT or MRI findings
- Assessment of blood flow within lesion
- Follow up studies

Standardised Echography:

Standardised echography is the combined use of standardized A scan, contact B Scan and Doppler echography

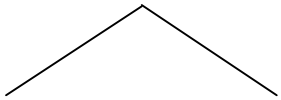
Standardised A Scan provides information on lesion's character and its size

B Scan technique :

Section of orbital tissue displayed on screen depends on how the probe is positioned and how the marker is directed .

B scan technique

for orbital lesions



Transocular Approach	**Paraocular approach**
1. Transverse	1. Transverse
2. Longitudinal	2. Longitudinal
3. Axial	

Transocular approach :

1) Transverse Scan :

- Probe is placed with longest diameter of probe tangential to limbus
- Sound beam oscillates across the opposite fundus, producing circumferential slice
- Direction of probe marker towards the nose for horizontal transverse scan
- Shows lateral extent of lesion

2) Longitudinal scans :

- Probe is placed with longest diameter perpendicular to limbus
- Marker oriented towards centre of cornea and meridian being examined

- Sound beam sweeps along the meridian opposite the probe
- Provides antero-posterior extent of lesion

3) Axial scan:

- Probe is placed over centre of cornea when fixating in primary position
- Sound beam directed towards centre of lens and optic nerve
- Horizontal axial with marker towards nose
- Vertical axis with marker oriented superiorly
- Lesion displayed in relation to globe and optic nerve

B) Paraocular approach:

Demonstrates anterior lesion in relationship to globe and orbital wall.

1) Transverse scan:

- Demonstrates lateral extent and posterior border of anterior lesion
- Longest diameter oriented parallel to orbital wall

2) Longitudinal Scan:

- Peripheral globe and anterior lesion demonstrated simultaneously
- Longest diameter of probe is oriented perpendicular to orbital rim

B scan screening:

- Performed from superior-nasal-inferior-temporal quadrants postero - anteriorly
- Lacrimal gland region-longitudinal approach
- Lesions near posterior ocular wall, optic nerve and muscle cone-axial scan
- Compressibility-pressing the probe lightly on globe
- Valsalva maneouvre – to look for varices

Orbital lesions are evaluated by:-

Topographic echography: -

- Location - position and meridian
- Shape
- Borders
- Contour abnormalities – bone excavation, defects, globe indentation

Quantitative echography:

- Internal reflection indicates the spike height on A-Scan and signal brightness on B-Scan
- Internal structure refers to the difference in echo density on B Scan or histologic architecture of the lesion
- Sound attenuation refers to the decreasing brightness of echoes posterior/within a lesion due to scattering/reflecting/absorbing sound energy by a medium

Kinetic Echography:

Consistency : Soft Vs hard

Vascularity : Blood flow

Mobility of lesion or its contents.

Angle kappa , by Ossoinig , is formed by imaginary line drawn through peaks of internal spikes and horizontal baseline on an A Scan; steeper the angle, greater the attenuation .

- Mobility is checked when patient blinks or during a saccade
- Vascularity - Fast, flickering motion of internal echoes with probe and eye stationary indicates vascularity
- Shifting fluid- Lymphangioma with hemorrhage, hematomas and cyst

Orbital ultrasound provides most, if not all , diagnostic information available with other imaging techniques

Ultrasound remains a highly useful diagnostic methodology for its:-

1. Cost effectiveness
2. Non invasiveness
3. Detection of early and low grade inflammation changes in sclera, optic nerve and extraocular muscle
4. Less radiation hazards

5. Useful in determining size, extent and configuration of tumour esp. of lacrimal gland origin
6. Real time display of moving organ based upon geometric optics of reflection, refraction, diffraction and absorption
7. Flexible ; patient need not be inside a scanner
8. Does not require sedation for children , as it is painless; does not take much time.

Echography can differentiate the reflectivity, structure, sound attenuation , location, size, border, mobility and compressibility of lesion.

Doppler echography provides information regarding vascularity

B scan is useful for follow up of inflammatory, neoplastic lesion after surgery or conservative management to look for regression of size and extent of lesion, optic nerve and extraocular muscle involvement .

Advantages of CT scan:

1. Lesions affecting orbital and extra orbital fat are well visualized in almost any plane with reconstruction
2. Sensitive for bony involvement like moulding of bone in dermoid, lymphangioma, bone erosion, scalloping in inflammatory or neoplastic lesion
3. Sensitive for detecting calcification within orbital lesion and it is helpful in generating a differential diagnosis.
4. Main advantages are availability and speed; spiral scanning/reconstruction possible in almost any plane
5. Orbital apex, adjacent portions of brain, paranasal sinus, facial and nasopharyngeal soft tissues and optic nerve involvement are better visualised

Main disadvantages of CT scan over other imaging modalities:

1. CT uses ionizing radiation but 5 rads to orbit is less than the dose to induce cataract
2. Potentially, small risk of inducing subsequent tumour in pediatric patients
3. Allergic reaction for IV contrast reduced with nonionic contrast medium

Hence, orbital anatomy was visualized better by CT scan

Involvement of

- Bony wall
- Extent of disease process
- Involvement of orbital apex
- Sinus involvement
- Extraocular muscle involvement
- Bony and optic nerve compression well made out by CT scan

Bscan, devoid of ionising radiation, is a bedside study, has good spatial resolution and follow up of the patient is possible with serial B-scan

Diagnostic sequence:

Orbital imaging is done for 3 distinct purposes:

1) Is there a lesion?

2) Which lesion is it?

   (Nature of lesion-Malignant potential, tissue type, extension into other tissues)

3) Follow up imaging to monitor treatment

   How is it doing?

Current orbital CT/B-scan is good at answering “Is there a lesion?” question but inadequate in answering “Which lesion is it?”

MRI and biopsy are needed to decide on tissue type or malignancy

Due to their high resolution tumours of even few mm could be detected by B-scan to answer “How is it doing?”

Consequently management of orbital lesion is based on combination of

- History
- Clinical examination
- Radiological features or imaging studies
- Histopathology of biopsy specimen and other factors.

Computed tomography:

Entire orbit can be examined along with adjacent portions of brain, cavernous sinus and portions of paranasal sinus and facial and nasopharyngeal soft tissues

- Thin section of 3 mm thick in transverse planes;5 mm thick in coronal planes obtained routinely
- Sagittal and 3 dimensional reconstruction is useful in facial-orbital deformities
- Spiral CT is faster than conventional CT

CT Imaging parameters for orbit:

- High resolution
- 0.63 mm axials
- Pitch 1
- Table speed 1.25 cm/s
- Intravenous contrast medium

- Field of view 13 cm

Absorption values in orbital CT:

Tissue		**Hounsefeld units**
Air	-	1000
Fat	-	-70 to -100
Water	-	0
Optic nerve	-	+5 to +10
Vitreous	-	+5 to +15
CSF	-	4-10
Brain, Soft tissue	-	+35 to +45
Hemorrhage	-	+70 to 80
Calcification	-	+100 and above
Bone	-	+1000
Metal	-	> 1000

Hilal and Trokel technique is used to measure proptosis in CT scan. A straight line is drawn between anterior margins of zygomatic processes, which intersects the globe at/behind equator.

Distance between cornea and inter zygomatic line is normally 21 mm Asymmetry greater than 2mm or value above 21 mm indicate proptosis CT evaluation of optic nerve is done with 1.5 mm axial scan and contrast study. Patient should fix in upgaze to stretch the optic nerve and make it straight.

Superior Opthalmic vein : - Begins in supero-nasal quadrant of orbit near trochlea , course postero – laterally beneath the superior rectus and exits the orbit through superior orbital fissure, which is seen on high axial scans and coronal scans ;normal diameter is 2mm anteriorly and 3.5 mm posteriorly on coronal scan.

CT Assessment of orbital lesion: -

1. Size of lesion is assessed using geometric protractor .
2. Circumscription of lesion whether, well defined or diffuse.
3. Shape of lesion.
4. Margin of lesion(smooth/irregular).
5. Effect on surrounding structure and displacement or infiltration of optic nerve.
6. Internal consistency(homogenous or heterogenous).
7. Surrounding bone (fossa formation, erosion,hyperostosis).
8. Relationship to optic nerve, extra ocular muscle, sup. orbital fissure, and Optic foramen
9. Location and posterior extent of lesion

<u>B-scan and CT scan findings of common orbital lesions:</u>

Optic nerve tumours:

Acoustic characteristic of optic nerve tumours:

a) rounded configuration
b) sharp anterior borders
posterior extent cannot be delineated
c) high acoustic absorption ; so orbital wall cannot be outlined
d) homogenic with few internal echoes.

Disorder	Reflectivity	Internal structure	Thirty degree test
Glioma	Low-medium	Regular	Negative
Meningioma	Medium-high	Irregular	Negative
Increased SAF	Variable	Irregular	Positive

Optic nerve Gliomas: -

Smooth, fusiform or ovoid mass replacing the normal optic nerve void with low-medium reflectivity.

Optic nerve sheath meninigiomas:

Meningiomas are irregular and nodular on B scan

Optic nerve head conditions like melanocytoma, medullated nerve fibres, epipapillary membranes, are seen as dense echogenic masses, ONH papillitis/edema appears as fullness in region of ONH with presence of few vitreous cells anterior to it.

Thirty degree test:

Ossoinig developed it to differentiate increased subarachnoid fluid from the thickening of optic nerve parenchyma using A-scan technique; maximum thickness of optic nerve is measured both anteriorly and posteriorly in primary gaze and patient fixing 30deg or more towards the probe. The test is positive if nerve pattern decreases by atleast 10% at 30deg gaze as compared to primary gaze. The test is positive in patients with increased subarachnoid fluid

Secondary and metastatic tumours of optic nerve:

Such as retinoblastoma and melanoma, leukemia infiltrate optic nerve causing thickening which is difficult to differentiate from primary lesions of optic nerve.

Optic neuritis: -

- enlarged nerve pattern
- regular/irregular internal structure
- thirty degree test result variable

CT features of optic nerve lesion: -

ON glioma: - Nodular/fusiform enlargement of nerve with contrast enhancement

Meningioma: - Irregular margin, associated with calcification, optic canal widening, tramtrack sign.

Causes of enlarged optic nerve sheath complex:

Neoplasms like:

- Optic nerve glioma
- Meningioma
- Neuroma
- leukemia
- lymphoma
- Metastasis

Others:

- Enlarged pseudotumour
- Optic neuritis
- Sarcoidosis
- Distended subarachnoid fluid
- Thyroid ophthalmopathy

- Tuberculosis
- Toxoplasmosis

Cystic lesions of orbit:

Most cystic lesions share common features of

- Smooth contour
- Round to oval shape
- Sharp outline
- Absence of internal reflectivity

Dermoid/epidermoid cyst: -

- Oval lesion in upper lid
- Moderately regular internal structure with variable reflectivity and sound attenuation

Dermolipoma:

- Fat filled, difficult to distinguish from orbital soft tissue
- High reflectivity, non vascular

Epithelial cyst:

- Arise from conjunctiva or orbit
- Round lesion, smooth contour
- Filled with serous fluid – low reflective

Anophthalmos with Cyst:

- Cystic structure varies in size located superficial or deep in orbit that lacks optic nerve and lens. Other cystic lesions are hematic cyst, congenital cystic eye, teratoma, lacrimal duct cyst and mucocele

ORBITAL TUMOURS:

(A) Shwannoma:

- low to medium reflective
- Regular internal structure
- Moderate sound attenuation

(B) Neurofibroma (Solitary type):

Regular internal structure

Low to medium internal reflectivity

Mild to moderate sound attenuation

Plexiform type has infiltrative, non-encapsulated lesion, irregularly shaped, poorly outlined on B scan

(c) Pseudotumour and Lymphoma:

Include scleritis, episcleritis, myositis and perineuritis

- Focal/multifocal-located any where in orbit
- Well circumscribed with smooth contour
- Diffuse/irregularly shaped
- Attached to extraocular muscle, optic nerve, periosteal or globe
- Low to medium reflective with regular internal structure; connective tissue septa give irregular appearance

Echographic differentiation of pseudotumour and lymphoma is difficult but

1) Thickening of extra ocular muscles
2) Edema in subtenons space
3) Scleritis is more common with pseudotumour

On CT, lymphoma has bilateral involvement of lacrimal gland or mass in lacrimal fossa, contrast enhancing mass in retroconal space obliterating normal soft tissue planes; difficult to differentiate from pseudo tumour Pseudotumour has contrast enhancing uveoscleral thickening; lesion is iso to hyperintense to muscle, thickening of recti along with tendon, perioptic enhancement and enlarged lacrimal gland.

4) Rhabdomyosarcoma:-

- Located anywhere in orbit, but commonly superiorly
- Well circumscribed large lesion
- Low to medium internal reflectivity with moderate sound attenuation

On CT,it appears as enhancing iso to hyperdense mass infiltrating retrobulbar fat and involve posterior aspect of globe

5) Fibrous histiocytoma:

- Occur extraconal or rarely fill the orbital cavity
- Oval, well outlined and exhibit regular internal structure
- Low to medium internal reflectivity
- Moderate sound attenuation

6) Metastatic and secondary tumour:

- Infiltrating metastatic tumour tend to be irregularly shaped and poorly outlined
- Medium to highly reflective
- Moderately regular internal structure
- Nodular rectus muscle thickening

On CT scan: Erosion of orbital wall and extension of sinus tumour to orbit; maxillary mass causes destruction of orbital floor and invasion of mass into orbit with displacement of globe superiorly.

7) Lacrimal system disorders:

Normal orbital soft tissues are highly reflective so the gland cannot be delineated from orbital soft tissues.

a) Pleomorphic adenoma:

Orbital lobe involvement can cause globe indentation and bony excavation

- Medium to high reflective lesion with regular internal structure, moderate sound attenuation.
- Well outlined-capsulated

Adenoid cystic carcinoma:

- Infiltrative, sometimes circumscribed
- Medium to high reflective irregular internal structure
- Moderate to strong sound attenuation
  Sometime have cystic cavities, bony excavation, and destruction

Mucoepidermoid Carcinoma:

Well circumscribed, medium to high internal reflectivity, moderately regular internal structure with globe indentation, excavation of lateral orbital wall.

Dacryoadenitis:

- Diffuse, highly reflective, non-vascular enlargement of lacrimal gland and surrounds orbital soft tissue

Lacrimal abscess:

- Enlargement of circumscribed lesion; low reflective lesion

Dacryops:

- Round oval or lobulated and well outlined
- Unilateral or bilateral
- Smooth contour and low reflective.

On CT,

Lacrimal fossa lesions show marked contrast enhancement. Benign lesions do not usually cross vertical midline of orbit. Pleomorphic adenomas are nodular, well delineated lesions with moderate contrast enhancement, smooth well defined margin.

Malignant neoplasm produce irregular mass with poorly defined margins, moderate contrast enhancement, intralesional calcification and bony destruction and cross vertical midline.

Retinoblastoma:

- Can infiltrate the optic nerve or extend into orbit, but difficult to detect with B scan because of shadowing from intraocular calcification
- May produce orbital cellulitis that may not be related to extra ocular extension

Melanomas-

Melanomas are associated with ciliochoroidal detachment, scleritis, episcleritis, and orbital inflammation with/without extra ocular extension of tumour.

Extrascleral extension of melanoma

- appears as one/more nodules located near sclera, adjacent to base of tumour

Thickness of nodule is detected when atleast 1.5 mm and follow up examination is useful to look for increase in size or changes in configuration

Orbital cellulitis:

Hyperechoic lesion in extra conal fat with scleral thickening. CT finding include proptosis with intraconal fat showing abnormal density; scleral thickening, subperiosteal abscess, preseptal swelling.

Can also be associated with – lacrimal sac swelling, osteitis/erosion of surrounding bone

Vascular lesions of orbit:

A) Lymphangiomas:

- Location, size and outline are well demonstrated
- Irregular outline; tumor is not encapsulated and extends diffusely through the orbit
- Numerous fingerlike projection of tumour into retrobulbar fat pattern
- Acoustic borders are moderately well defined
- Demonstrate definite acoustic hollowness
- Posterior extent is well outlined acoustically
- Internal structure is irregular due to mix of high and low reflectivity
- Hemorrhage within lymphangioma is low reflective due to unclotted blood
- Bscan is used to guide positioning of the needle for aspiration.

On CT Scan: have irregular margin, multiloculated , heterogenous lesion and enhance prominently with contrast.

B) Capillary hemangioma:

- High reflectivity because of dense capillaries
- Indistinct borders since they are located superficially/ deep within orbit
- Lesions involving entire orbital cavity are more highly reflective ; mistaken for normal orbital soft tissue

On CT scan: - irregular margin and enhance prominently with contrast

- A widened orbital soft tissue pattern compared with that of normal fellow orbit
- Sometime associated with thickening of extra ocular muscles and dilatation of superior ophthalmic vein.

Cavernous hemangioma: -

- Highly reflective lesions due to large interfaces, vascular channels filled with stagnant blood and no internal vascularity
- Regular internal structure and exhibit marked sound attenuation
- Intraconal with lack of significant indentation of ocular wall
- Sometime extraconal or even within lid

On CT scan, homogenous mass within muscle cone, with smooth margin and uniform contrast enhancement

Tumor type	Shape	Borders	Internal reflectivity	Internal structure	Sound attenuation
Cavernous hemangioma	Round/oval	Well outlined	High	Regular	Moderate
Capillary hemangioma	Irregular	Poorly outlined	High	Irregular	Variable
Lymphangioma	Irregular	Poorly outlined	Low	Irregular	Variable
Hemangio pericytoma	Round/oval	Well outlined	Medium	Regular	Moderate

Arteriovenous malformation:

- Irregular internal structure because of very low reflective, fast flowing blood and higher reflectivity of vessel walls
- Generalised increase in size of orbital soft tissue
- Associated with choroidal detachment, sometimes.

Orbital aneurysm:

- Well outlined, low reflective with regular internal structure
- Is more localised – usually in anterior aspect of orbit unlike fistula, where dilated superior ophthalmic vein extends from supero nasal orbit to orbital apex.

Orbital Varices:

- On performing valsalva maneuver, appearance of well outlined, low to medium reflective orbital lesion
- Appear as a large mass or have a tubular shape of a blood vessel

On CT, appearance and disappearance of lesion with changes in head position.

Cavernous sinus fistulas:

1) Orbital soft tissue swelling – causing widening of the normal orbital soft tissue pattern
2) Mild enlargement of extra ocular muscles with medium to high reflectivity
3) Widening of the optic nerve pattern as a result of increased subarachnoid fluid
4) Dilated superior ophthalmic vein is undetectable in normal orbit

In **low flow type,** internal reflectivity of dilated vein is low- medium due to partial thrombosis of low flow fistula, resulting in large interfaces and a more heterogenous echography.

On CT scan: - enlargement of superior ophthalmic vein, recti muscles are enlarged; proptosis and distension of involved cavernous sinus.

LACRIMAL SAC: In normal situation, the sac can be identified as small, low reflective structure

DACRYOCYSTITIS:

A dilated sac is much easier to image.

Dilated sac is typically very low reflective, although high reflectivity may be detected if mucus is present.

Dacryolith - may appear as highly reflective echo dense nodule within dilated sac

Extra ocular muscles:

- Echography is more effective for detecting subtle or rarely changes in muscle size
- Slight oblique section on CT/MRI – result in misinterpretation regarding muscle enlargement
  This is less likely to occur with ultrasound because the examiner constantly adjusts the probe position to prevent oblique sectioning

- B scan also useful for differentiating the
  - Various causes of muscle enlargement
  - Detecting associated orbital abnormalities
  - For follow up during therapy
- B scan is useful for documenting the gross size and contour of muscle, whereas, A scan evaluation allows precise measurement of thickness.

Examination techniques for rectus muscle:

Patient fixates in primary gaze or approximately 10degreestowards muscle being examined.

A) Transverse Scan:

- Display muscle in cross section
- Probe placed on globe near equator on the side of the globe opposite from muscle being evaluated.
- Appears as oval shaped defect within echodense orbital soft tissues.

B) Longitudinal Scan:

- one with the patient fixating slightly away from the probe, towards the muscle being examined
- probe is placed on the side of the globe, opposite to the muscle

- marker is always directed towards centre of cornea and muscle being scanned.

Normal extra ocular muscle values:

Muscle	Normal range (mm)	Difference between contralateral muscles
Superior rectus levator complex	3.9 – 6.8	0.8
Lateral rectus	2.2 - 3.8	0.4
Inferior rectus	1.6 - 3.6	0.4
Medial rectus	2.3 - 4.7	0.5
Sum of all muscles	11.9 – 16.9	1.2

Extra ocular muscle disorders:

Thyroid ophthalmopathy (Graves' disease)

Muscles most commonly enlarged in B scan are superior rectus/levator complex and the medial rectus; differs from the clinical presentation of Graves disease in which the inferior rectus muscle is most frequently affected.

- Bilateral, asymmetric muscle thickness is the rule
- Mid and posterior potion of muscle belly are involved
- Internal reflectivity is typically medium to high, structure is quite irregular
- Associated with swelling of orbital fat and lid tissues, enlargement of lacrimal gland and thickening of periorbita
- In cases of marked apical muscle swelling, superior ophthalmic vein can be enlarged.

Myositis:

Myositis prouces inflamed, thickened muscle whereas, Pseudotumor shows an orbital mass of inflammatory etiology Myositis is unilateral/bilateral, affecting one or all the extra ocular muscles. The muscle is diffusely thickened with involvement of both tendon and belly fibres. Internal reflectivity in myositis is low due to diffuse invasion of muscle fibres by inflammatory cells, rendering the tissues more homogenous than normal. Associated with episcleritis, scleritis, adjacent to inserting tendon, inflammation of lacrimal gland or optic nerve.

Tumours infiltrating extra ocular muscles:

- Metastatic carcinoma
- Lymphoma
- Sarcoma
- Metastatic melanoma
- Amyloidosis

Differential diagnosis of extra ocular muscles:

Diseases	Reflectivity	Internal structure
Thyroid ophthalmopathy	Medium-high	Irregular
Myositis	Low	Regular
Tumours	Low-Medium	Regular
Venous congestion	Medium – high	Variable
Hematoma	Low – Medium	Regular

Also seen in conditions associated with venous congestion like:

- Carotid cavernous fistula
- Diffuse inflammatory disease
- Orbital apex syndrome
- Cavernous sinus thrombosis

- AV malformation
- Orbital cellulitis

All cause unilateral enlargement of all muscles on affected side. Internal reflectivity of thickness muscle can be normal or moderately high associated with orbital soft tissue swelling and enlargement of optic nerve.

Muscle thinning:

- Can be seen in long globes with large posterior staphylomas
- Congenital fibrosis of muscle
- Long standing thyroid ophthalmopathy

Etiologies of enlarged superior ophthalmic vein:

- Carotid cavernous fistula
  -traumatic

  -dural fistula (AVM)
- Orbital apex mass
- Thyroid ophthalmopathy
- Idiopathic orbital inflammation
- Capillary hemangioma
- Normal variant
- Varices
- Superior ophthalmic vein or cavernous sinus thrombosis

Globe calficiation:

In infant or young child (upto 3 years), any focal calcification in the globe-must be considered a retinoblastoma until provided otherwise Phthisis bulbi – end stage, calcified, shrunken globe which is blind.

On CT, extensive calcification is seen.

AIMS OF THE STUDY

To study the ultrasound B-Scan findings in orbital disorders , to correlate the findings with CT scan of orbit , to study how ultrasound B-Scan is valuable as part of initial clinical work up and for the follow up of orbital disorders.

MATERIALS AND METHODS

This is a prospective study underwent in RIO-GOH from May 2010 ï October 2011 in which 70 patients suspected to have orbital involvement underwent routine proptosis workout with appropriate laboratory and radiological investigation and presumptive clinical diagnosis made.

All patients were subjected to ultrasound B-scan using OTI Scan ï 1000 with USG probe of 7.5 ï 10 MHZ. All patients were examined in supine position with lids closed.

In all cases, the clinical and B-scan diagnosis were correlated with orbital CT scans of axial and coronal sections to infer the accuracy of diagnosis

Inclusion criteria:

Patients presenting with proptosis, enophthalmos, globe displacement, orbital, lid mass or restriction of extra ocular motility

Exclusion Criteria:

Patients presenting with intraocular involvement, trauma cases and intraocular foreign bodies.

Evaluation of the Patients:

All the patients underwent thorough ocular and orbital examinationHistory was obtained about the onset, deviation and progression of protrusion of eyeball. History of diplopia, pain and defective vision were elicited. Past history of diabetes, hypertensionand thyroid disorders were elicited.

Examination:

1. Lids, pupil, extra ocular movts, visual acuity assessment
2. Differential intraocular pressure
3. Slit lamp biomicroscopy of anterior segment
4. Fundus examination by indirect ophthalmoscopy
5. Forced duction test
6. Visual field assessment and colour vision
7. Diplopia charting
8. Assessment of proptosis

Degree of preseptal, pretarsal and conjunctival edema was documented. Psychophysical examination included a study of best corrected visual acuity, confrontation visual fields, central visual acuity using Amsler grid and color vision assessment

Pupillary examination included size, symmetry, light and near reaction as well as afferent pupillary defects

Orbital examination documented degree of horizontal, vertical and antero posterior displacement of globe. Visible pulsation, fullness, increase in proptosis on valsalvamaneuver palpable mass, resistance to retropulsion, compressibility and reducibility of lesion were looked for. Ocular movements documented by recording ductions and version in four cardinal positions by degrees and intraocular pressure recorded in primary position and upgaze in restricted movements

Biomicroscopy of cornea, conjunctiva and fornices was done. The fundus, optic nerve head, retinal blood vessels and choroid examined with direct and indirect ophthalmoscopy.

Investigations done:

- CT orbit ï axial and coronal with or without contrast
- Ultrasound Ascan and Bscan of orbit
- Thyroid function tests for axial proptosis in relevant cases.

Follow up:

Follow up includes a record of management, outcome, progression or regression of lesion with or without therapy.

Follow up with Bscan and CT scan are done in selected patients.

During the follow up period,

- Best corrected visual acuity
- Presence of diplopia and range of extra ocular motility
- Measurement of proptosis
- Pupillary, visual field, colour vision assessment are done
- Progression or regression of lesion were looked for in Bscan examination

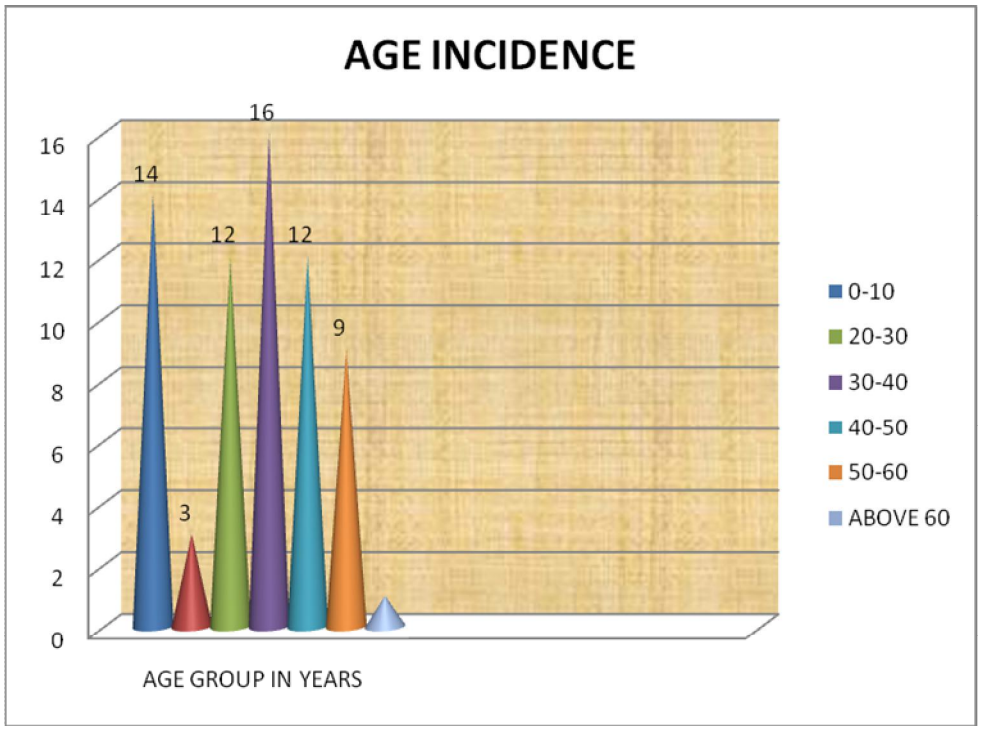
ANALYSIS AND DISCUSSION

ANALYSIS OF AGE AND SEX INCIDENCE OF ORBITAL DISORDERS

Age group in years	Male	Female	Total	%
0 ï 10	7	7	14	20
11 ï 20	1	2	3	4.3
21 - 30	5	7	12	17.14
31 ï 40	6	10	16	22.85
41 ï 50	9	3	12	17.14
51 ï 60	8	1	9	12.85
>60	3	1	4	5.71
Total	39	31	70	100

In our study, age analysis showed maximum number of patients with orbital disorders were in 30 ï 40 age group followed by children <10 years

Sex analysis showed a male predominance compared to female



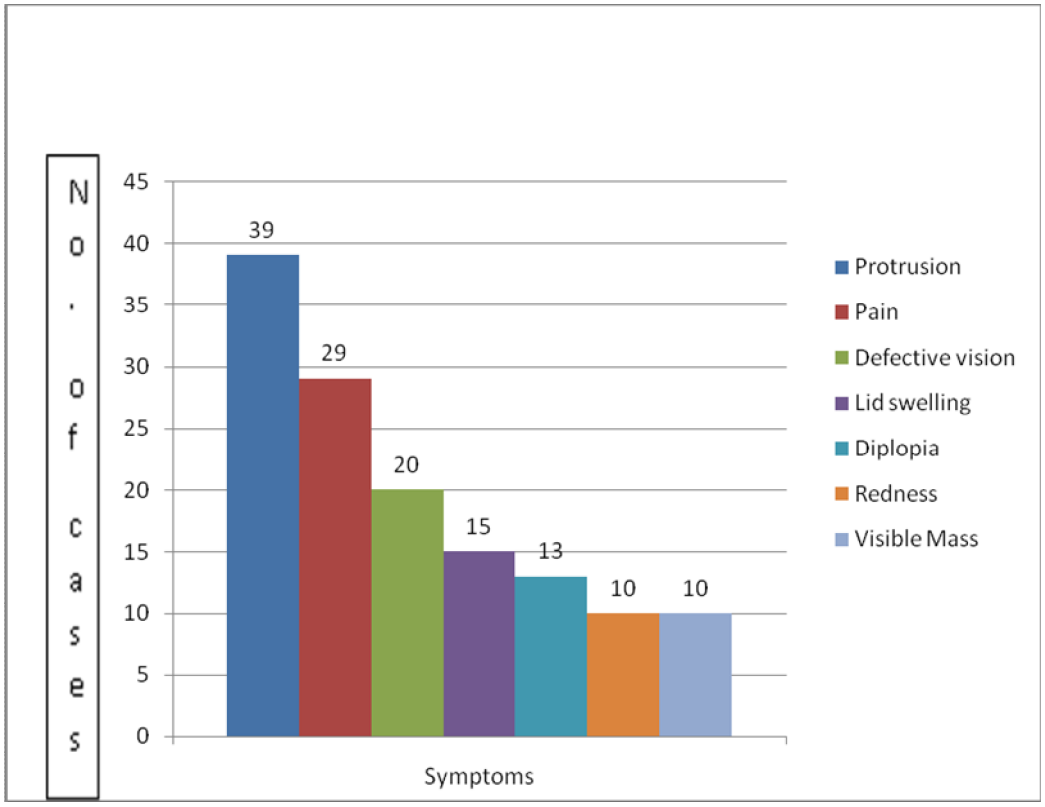
ANALYSIS OF SYMPTOMS:

SYMPTOMS	No. of cases	%
Protrusion of eyeball	39	55.71%
Pain	29	41.43%
Defective vision	20	28.57%
Lid swelling	15	21.43%
Diplopia	13	18.57%
Redness	10	14.28%
Visible mass	10	14.28%

Most common symptom among orbital disorders presented to us was of protrusion of eyeball followed by pain.

(Chief clinical features was diminution of vision according to orbital sonography with its clinico surgical correlation ï IJRI ï vol ï 15, issue 4, 2005)

ANALYSIS OF SYMPTOMS


No. of cases
45
40
35
30
25
20
15
10
5
0
39
29
20
15
13
10
10
Symptoms
Protrusion
Pain
Defective vision
Lid swelling
Diplopia
Redness
Visible Mass

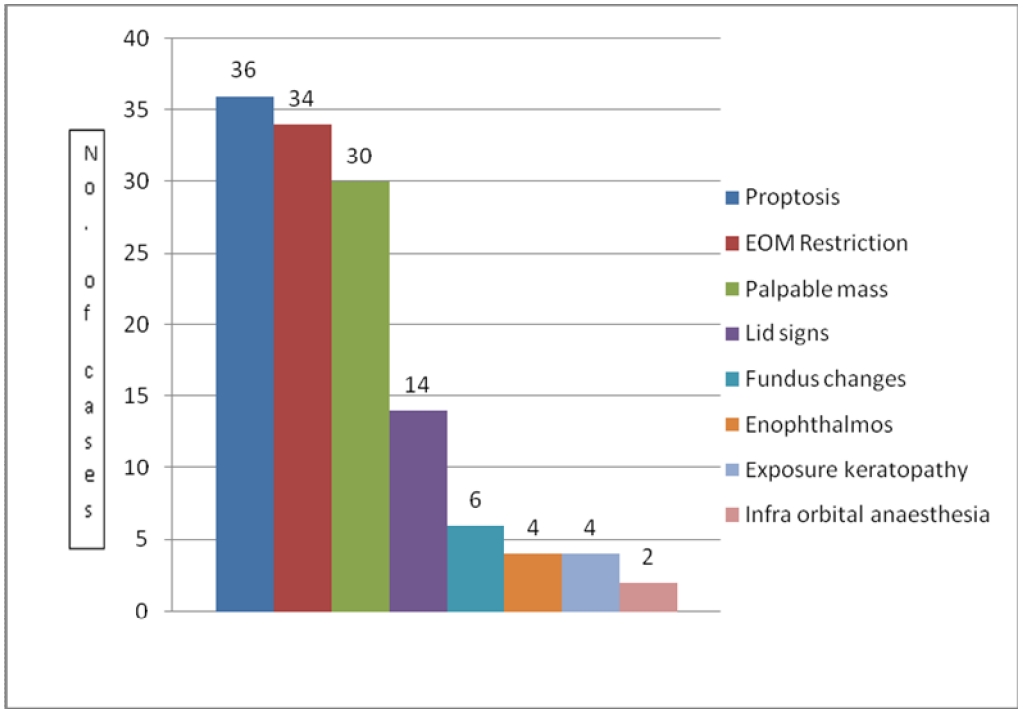
ANALYSIS OF SIGNS IN ORBITAL DISORDERS:

Signs	No. of cases	%
Proptosis (Axial or Eccentric)	36	51.43%
EOM restriction	34	48.57%
Palpable mass	30	42.85%
Lid signs(lag, retraction, swelling, ptosis)	14	20%
Fundus changes (Disc edema, optic atrophy, choroidal folds)	6	8.57%
Exposure keratopathy	4	5.71%
Enophthalmos	4	5.71%
Infra orbital anaesthesia	2	2.85%

Patients with associated posterior segment injuries and intra ocular foreign bodies were excluded from our study.

Most common sign seen in orbital disorders elicited in our study was proptosis followed by EOM restriction.

ANALYSIS OF SIGNS IN ORBITAL DISORDERS

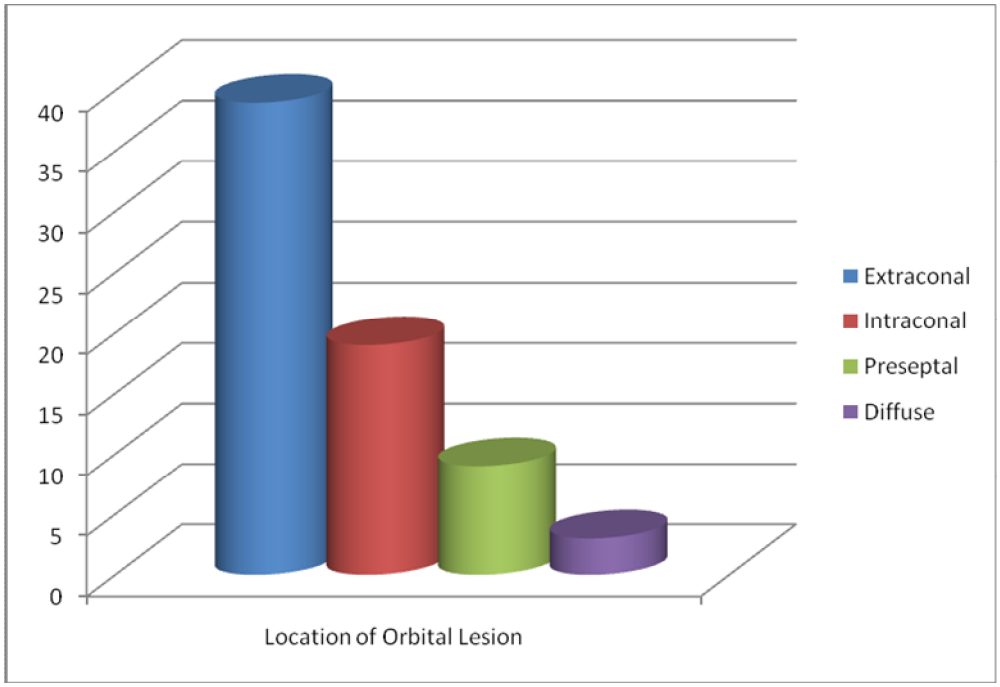


ANALYSIS OF LOCATION OF LESION:

Location	No.of cases	%
Extraconal lesion	39	55.7
Intraconal lesion	19	27
Preseptal lesion	9	12.85
Diffuse intra and extraconal lesion	3	4.3

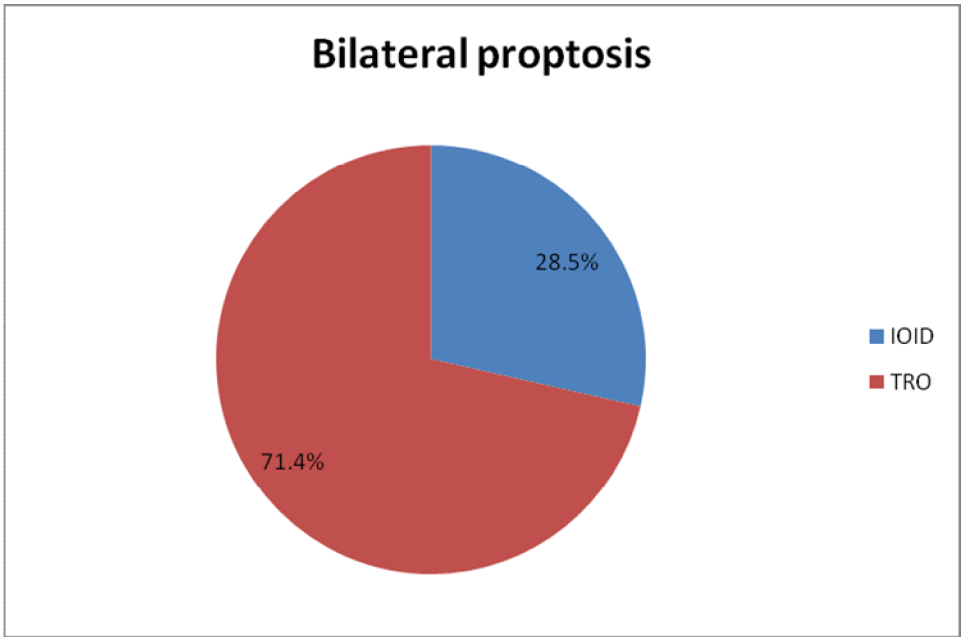
Out of 70 cases presented to us with orbital pathology the most common location in orbit was of extraconal space (outside the muscle cone) 39 cases (55.7%) followed by 19 patients whose lesions presented intraconally (27.14%)

ANALYSIS OF LOCATION OF LESION:



Bilateral Involvement:

7 cases had bilateral involvement of which thyroid ophthalmopathy accounted for 5 cases (71.4% bilateral proptosis) and idiopathic orbital inflammation accounted accounted for 2 cases (28.57% of bilateral proptosis) in our study.


Bilateral proptosis
28.5%
71.4%
IOID
TRO

ETIOLOGY OF PROPTOSIS

Diagnosis **ORBITAL TUMOURS**	No.of cases **22**	% **31.42**
Lacrimal gland tumour	4	5.7
Glioma	3	4.28
Meningioma	1	1.42
Rhabdomyosarcoma	2	2.85
Neurofibroma	2	2.85
Dermoid cyst	4	5.4
Lymphoma	4	5.7
Lid carcinoma	2	2.85

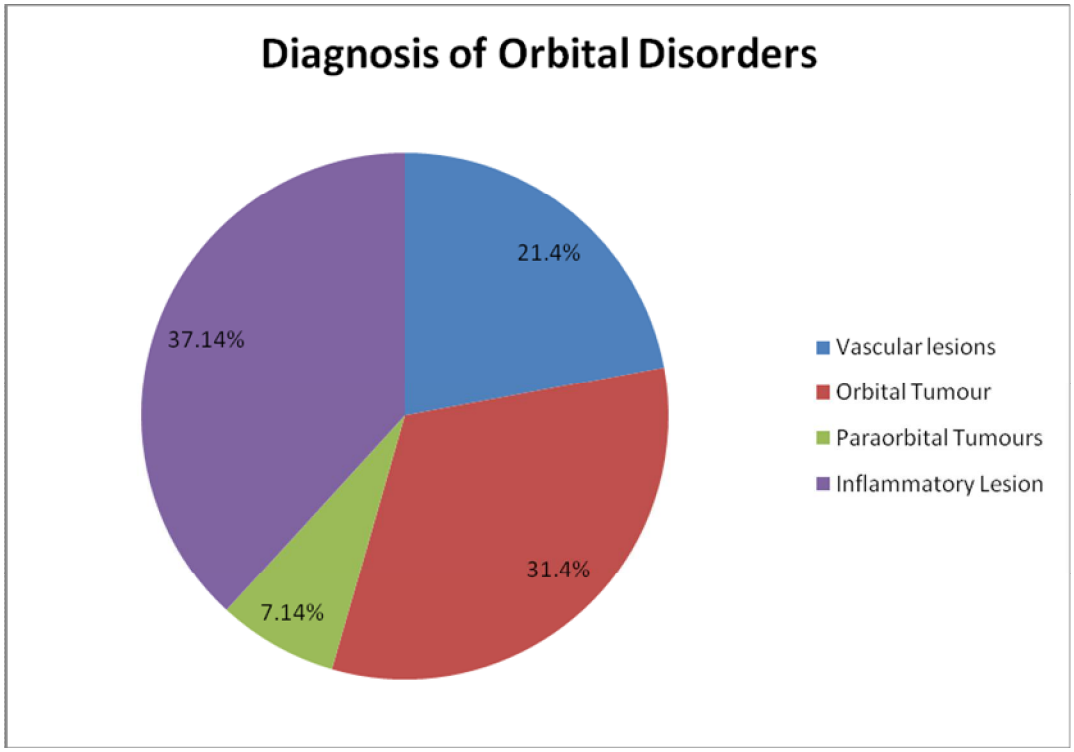
Diagnosis **Para Orbital tumours**	No.of cases **5**	% **7.14**
Carcinoma of ethmoid sinus	1	1.42
Carcinoma of maxillary sinus	2	2.85
Fibrous dysplasia	2	2.85

Diagnosis **Inflammatory lesions**	**No.of cases** **26**	**%** **37.14**
Idiopathic orbital inflammatory disease	8	7.14
Thyroid related orbitopathy	10	14.28
Orbital cellulitis	5	1.42
Cysticercosis	1	2.85
Mucormycosis	2	2.85

Diagnosis **Vascular lesions**	**No.of cases** **15**	**%** **21.42**
Capillary hemangioma	5	7.14
Cavernous hemangioma	2	2.85
Lymphangioma	3	4.28
Retro bulbar hematoma	2	2.85
Carotid cavernous fistula	2	2.85
Orbital varices	1	1.42

Most common lesion among orbital disorders in our study wasthyroid related orbitopathy 10 cases (14.28 %) followed by idiopathicorbital inflammatory disease (8 cases) (11.43%).

In 70 cases suspected to have orbital involvement by history and clinical examination, we were able to detect the location of lesion in 61 cases and demonstrate the location and extent of lesion in them.



Lacrimal gland tumours:

In our study, 4 cases of lacrimal gland tumours were diagnosed and they presented with eccentric proptosis.

2 cases showed on sonography, a capsulated, rounded, hyper echoic mass in lacrimal fossa with well-defined margin suggestive of

lacrimal gland tumour. Benign nature of pleomorphic adenoma was confirmed on CT scan and histopathology in both cases.

38 years old female presenting with pain and eccentric proptosis on sonography showing hypo echoic mass in superolateral extraconal space, CT scan showed hyperdense mass lesion with bony erosion of suerolateral orbital wall and intracranial extension of tumour.

Similar Picture was observed in a 40 yr old female with sonographic picture of unencapsulated diffuse high reflective mass in extraconal space, indenting globe from behind CT scan confirmed malignant lacrimal gland tumour by showing irregular hyperdense mass lesion, invasion of lateral rectus and extending to orbital apex.

Histopathology (of excision biopsy) of first 2 cases were confirmed as pleomorphic adenoma and of later 2 cases as adenoid cystic carcinoma

In our study, CT scan helped to confirmin addition to Bscan, apical involvement, bony destruction, posterior limit of tumour extension and localization

According to orbital ultrasound ï a diagnostic tool/ISO/1983/vol3, CT scanning and orbital radiology are of limited value in diagnosis of orbital inflammatory disease, changes being beyond the resolving capacity of instruments available today. Moreover, invasion of optic nerve is often difficult to diagnose]

Lymphoma:

In our study, 4 cases of lid swelling with ptosis showed on ultrasonography, a diffuse, low reflective lesion in lid extending into superior extraconal space.

Ultrasound and clinical diagnosis of lymphoma was correlated with CT scan and FNAC diagnosis on CT scan, all 4 cases appeared as contrast enhancing hyperdense mass in lacrimal fossa and lid extending into extraconal space with no bony involvement. Moderately enhancing well defined homogenous lesion was moulding to adjacent bony structure, one case showed extension to orbital apex, no calcification was noted FNAC of all 4 cases confirmed as Bcell lymphoma.

Optic nerve glioma:

3 cases of apical proptosis with defective vision were diagnosed as optic nerve glioma by B scan which showed widening of optic nerve shadow, sharply defined, homogenic mass with few internal reflections. CT scan confirmed them as optic nerve glioma by showing contrast enhancing fusiform enlargement of optic nerve with one case showing intracranial extension

Optic nerve meningioma:

A case of axial proptosis showed enlargement of optic nerve shadow with irregular internal structure, suggestive of meningioma, which was confirmed on CT scan which also showed calcification and optic canal widening

Neurofibroma:

2 cases of lid swelling with eccentric proptosis were examined on Bscan to have infiltrative, non encapsulated, irregular lesion in lid on B scan. Clinical and sonographic picture of neurofibroma was confirmed on CT scan which showed soft tissue infiltration of superior and anterior extraconal space and lid. Also showed widening of orbit, inferior displacement of the globe and defects in greater wing of sphenoid

Rhabdomyosarcoma:

A 9 year old boy presented with a large lesion in superior aspect of orbit, Bscan showing diffuse, heterogenous mass with low reflectivity. On CT scan, mass appeared as enhancing, isodense lesion infiltrating retroorbital fat and indenting posterior aspect of globe

Similar Bscan finding was observed in a 4 year old boy with proptosis and predominant lower lid swelling. CT scan showed hypodense solid lesion in inferior orbit, displacing globe upward and involving intraconal space causing optic nerve compression

Rhabdomyosarcoma was considered in the differential diagnosis along with orbital cellulitis

Inflammatory lesions:

Thyroid related orbitopathy:

2 cases of thyroid related orbitopathy had normal orbit acoustically and one case showed just increase in retrobulbar fat complex, CT scan orbit in these 3 cases showed minimal enlargement of muscle belliesof few extra ocular muscles

3 cases of thyroid orbitopathy had bilateral symmetric enlargement of lateral and medial recti above the normal value with medium internal reflection associated with increase in retrobulbar fat complex; and 2 cases presented with unilateral irregular enlargement of medial and inferior rectus sparing the muscle insertion. CT scan of these 5 cases confirmed the same. One patient in addition showed features of optic nerve compression and lacrimal gland enlargement on CT scan.

Idiopathic orbital inflammatory disease:

Idiopathic orbital inflammatory disease was diagnosed in 6 cases of which Bscan showed well circumscribed, low reflective homogenous mass lesion with associated scleritis (characteristic Tsign) in 1 case. Out of 6, which had mass lesions, 4 had hypoechoic intraconal mass lesion and 2 cases had anterior orbital involvement (lacrimal fossa) along with unilateral multiple extra ocular muscle thickening of belly and tendon insertions 3 cases had no mass lesion but only widening of orbital soft tissue

On CT scan, 6 cases were confirmed to have contrast enhancing intraconal mass lesion along with extra ocular muscle enlargement (belly and tendon insertion); one of which had optic nerve compression. Optic canal was not involved; there was no calcification, 2 cases were associated with ethmoid and sphenoidal sinusitis, each

One case of orbital inflammation, presenting with proptosis, though did not reveal any ultrasound finding, but on CT scan showed tendon and belly enlargement of medial and lateral rectus.

Orbital Cellulitis :

2 cases of middle aged diabetic patients showed features of irregular poorly defined hyperechoic lesion in retrobulbar space . CT scan and clinical picture confirmed orbital cellulitis with intraconal fat showing abnormal density associated with preseptal swelling, obliteration of adjacent fat planes, also associated with erosion of surrounding bone.

3 cases showed features of orbital abscess in extraconal spaces as hyperechoic lesion in retrobulbar space associated with scleral thickening. CT scan confirmed orbital abscess in these 3 cases showing contrast enhancing rim of poorly defined mass and one of them showing sub periosteal abscess just lateral to lamina papyraceae , one case in addition showed features of optic nerve compression.

CT scan orbit demonstrated enlarged lacrimal sac as possible source of infection in two of these patients and ethmoid and sphenoidal sinusitis in one of them.

Mucormycosis:

2 cases of orbital mucormycosis, proved on histopathological examination by endoscopic biopsy, showed diffuse, ill-defined mixed echogenic mass lesion in inferior extraconal space. CT orbit in addition, showed enlargement of optic nerve shadow, maxillary and ethmoidal sinus opacification with bony sinus wall erosion. One of them showed extension into the superior orbital fissure.

Mucocele:

In our study, two cases of frontal mucocele showed well defined cystic lesion in superior extraconal region with few internal echoes. CT orbit showed non enhancing extraconal cystic mass in superomedial quadrant of orbit with expansion and erosion of bone associated with frontal sinus involvement.

Orbital Cysticercosis:

7 year old male presenting with proptosis and fever, had an encapsulated heterogenous cystic lesion in superior extraconal space, not involving superior rectus muscle. CT orbit confirmed cysticercosis by

showing web encapsulated cystic lesion with scolex in cyst in superior extraconal space.

Vascular lesions:

Capillary hemangioma:

3 cases of strawberry nevus lesions presented on Bscan with areas of low reflectivity with indistinct borders in lid and no orbital extension. CT orbit with contrast showed well demarcated homogenous contrast enhancing lesion occupying periorbital soft tissue in these cases.HPE of excision biopsy confirmed hemangioma in two of them.

2 cases of hemangioma had mixed echogenic areas of low and moderate reflectivity extending from lid into superior extraconal space. CT scan confirmed capillary hemangioma by showing contrast enhancing lobulated lesion with finger like projections extending into surrounding structures associated with dilated ophthalmic artery feeding the lesion in one of them.

Lymphangioma:

Two cases of lymphangioma showed multiple cystic spaces in retrobulbar fat which are low reflective, adjacent to medial rectus. CT orbit demonstrated contrast enhancing lesion in superior and medial aspects of extraconal space involving multiple planes associated with loss of fat planes suggestive of lymphangioma.

One case of lymphangioma had irregular hyperechoic diffuse lesion in lid. CT orbit showed poorly defined contrast enhancing heterogenous lesion involving preseptal space. HPE confirmation was obtained in one of them.

Retrobulbar hematoma:

In our study, a three month old hemophiliac child with protrusion of left orbit with history of forceps delivery on sonography revealed a well-defined hypoechoic mass in retrobulbar area. According to Bergs et al , 1984 , RB hematoma surrounds optic nerve and tends to have a clover leaf like appearance.

Orbital varices:

A 30 year old female with mass lesion appearing on Valsalva manoeuvre shows contrast enhancing fusiform lesion increasing in size on valsalva in intraconal space,but,he had acoustically normal orbit.

Carotid cavernous fistula:

Two cases of carotid cavernous fistula had widening of retroorbital space suggesting orbital soft tissue congestion. CCF was considered in differential diagnosis which was confirmed in CT orbit

which showed dilated superior ophthalmic vein and enlargement of extra ocular muscle ipsilaterally.

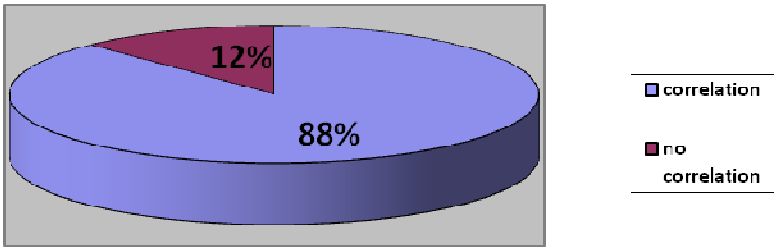
Cavernous hemangioma:

Two cases of axial proptosis on Bscan showed encapsulated cystic lesion in extraconal tissues. Our Bscan diagnosis of cavernous hemangioma was confirmed on CT orbit with contrast.

CORRELATION OF B-SCAN WITH CT ORBIT:

Out of 70 cases which were presented to us with orbital disorders, 61 cases (87.1 %) were diagnosed based on Bscan and clinical picture alone. And their diagnoses were well correlated with CT orbit.

In our study, 15 cases of orbital disorders were subjected to FNAC/histopathological examination of excision biopsy. Bscan diagnosis was correlating with histopathological diagnosis in all of them.



FOLLOW UP WITH SERIAL B-SCANS:

Thyroid Orbitopathy:

Serial follow up Bscans were done in Thyroid orbitopathy after treatment with antithyroid drugs and oral steroids. EOM thickness were assessed in three cases which showed:

Unit: mm

CASES	LATERAL RECTUS		MEDIAL RECTUS		INFERIOR RECTUS	
	Pre	Post trt.	Pre	Post trt.	Pre	Post trt.
Case 1	5.8	5.48	6.11	4.42	6.16	4.32
Case 2	4.42	4.36	6.28	4.08	6.18	4.56
Case 3	4.60	4.56	7.20	4.60	6.70	5.80

[Similar follow up study of EOM thickness was done by www.ktu.lt/ultra/journal/vol65/No.3 , 2010

Repeated ultrasound imaging of orbit demonstrated normalisation of EOM thickness, following conservative management.]

Orbital inflammatory disease:

3 cases of orbital inflammatory disease which had mass lesions were followed up with serial Bscans to look for regression of size of mass lesion. Posterior and lateral extent of tumour and extraocular muscle thickness were monitored with Bscan. All 3 cases showed regression in size of lesion.

Lacrimal gland tumour:

Two cases of lacrimal gland tumour (adenoid cystic carcinoma) were followed up after excision biopsy by Bscan, which showed residual lesion in extraconal space.

[Orbital ultrasonography - a diagnostic tool ï IJO/1983/Vol 31 / Issue 4 : ñ Regression of changes with therapy were detected first by echography before clinical changes become evident. Bscan is thus an important tool in diagnosis and management of orbital inflammatory lesion.ò]

Follow up of two cases of orbital abscess on Bscan showed regression of size of lesion following drainage of abscess.

RESULTS:

1) Orbital pathologies observed in this study were predominantly in 3rd ï 4th decade of life with male predominance(55.7%).

2) Chief symptoms were protrusion of eyeball (55.7%) followed by pain (41.43%) and most common sign elicited was proptosis (51.43%) followed by EOM restriction (48.5%).

3) Commonest orbital pathology to cause proptosis is due to inflammatory disorders (37.14%) followed by orbital tumours(31.42%). Thyroid related orbitopathy is the most common (14.28%) orbital lesion in our study.10% of cases had bilateral involvement of which thyroid related orbitopathy accounted for 71.4% of bilateral cases.

[Our finding did not correlate well with finding of Masud MZ et al (2006) who described neoplasm as most common cause of proptosis in their study]

4) Lymphoma and lacrimal gland tumours were most common orbital tumours in our study.

[Margo CE eta al reported orbital lymphoma to be most common malignant orbital tumour]

5) Most common para orbital tumour invading the orbit in our study was maxillary carcinoma [similar to that described by Johnson LN et al (1984)]

6) Bscan diagnoses were well correlating with CT scan diagnoses in all cases of lacrimal fossa disorders.

7) Bscan was very useful in locating and diagnosing vascular lesions in our study. 90 % of vascular lesions were diagnosed by clinical evaluation and Bscan diagnosis.

[According to www.ktu.lt/ultra/journal/Vol 65- 2010, ñ Dilated superior ophthalmic vein, widening of retroorbital fat and widening of extraocular muscles is gold standard of vascular malformation of orbitò]

8) Bscan was able to identify and diagnose almost all orbital lesions.

Bscan proved a cost effective, highly informative procedure in following up of cases of thyroid orbitopathy, orbital inflammatory disorders and orbital cellulitis. Since it poses no risk to the patients, Bscan may be repeatedly performed in order to evaluate treatment effectiveness or disease progression.

9) Extraconal space (55.7%) is the most common location of orbital lesion in our study followed by intraconal space (27%).

10) Orbital apex involvement occurred in 7 cases (10%). All of these cases were identified only by CT orbit.

11) 87% of cases in our study were diagnosed based on Bscan and clinical picture alone and the diagnosis was well correlating with CT scan and histopathology diagnosis. In 13 % of the cases, B Scan was not diagnostic . These cases include orbital varices, thyroid related orbitopathy, idiopathic orbital inflammatory disease and carotid cavernous fistula .

12) However, CT scan was required for its high sensitivity and specificity in localisation of intraorbital lesion, increased orbital fat, inversion of adjacent paranasal sinus, orbital apex involvement and intracranial extension. CT scan is fairly accurate in lesion characterisation. Bscan is of limited value in features described above.

[According to CT evaluation of proptosis ï IJRI vol 16, Issue 4, 2001 ñCT scan finding in relation to age of patient, clinical picture and lab investigations were able to give a correct diagnosis in 82 % of patients.ò]

13) Bscan in our study is of limited value in assessing paraorbital masses with orbital extensions and also bony abnormalities, for which CT scan is a superior diagnostic modality.

14) Bscan was 100 % effective in diagnosing orbital cellulitis. Role of Diffuse weighted imaging in orbital cellulitis was emphasised by

[Orbital infection ï imaging by Claudia Kirsch which demonstrated DWI confirming abscess without contrast enhanced images].

15) Thus, Bscan is a useful adjunct for rapid evaluation of pre and post septal involvement as well as for follow up examination.

SUMMARY

The clinical diagnosis together with Bscan findings were well correlated with CT scan and histopathological diagnosis. In our study, Bscan proved a valuable tool in assessing tumour location, configuration, extent and relationship to adjacent structures and thus helped to plan the approach for orbitotomies. Bscan also helped to follow up cases, especially of thyroid orbitopathy, orbital cellulitis, idiopathic orbital inflammatory disease , orbital tumours after conservative management and post orbital tumour removal

Use of CT orbit and ultrasound Bscan in evaluation of thyroid disease may be viewed as an addition to each other. Our study suggested that Bscan due to high sensitivity can support the diagnosis of thyroid orbitopathy.

Tissue differentiation by way of ultrasound is of great value due to its high sensitivity and resolution. In our study, Bscan was able to identify the nature of lesion in 87 % of cases. B Scan offered no diagnosis in 13% of cases due to orbital varices , thyroid related orbitopathy , idiopathic orbital inflammatory disease and carotid cavernous fistula .

However, in our study, CT orbit had advantage of superior anatomical information, high sensitivity and specificity for intraorbital tumours, detection of increased orbital fat and was useful in detecting apical involvement, invasion of adjacent paranasal sinuses and nasal cavity, intracranial extension which helped in pre-treatment evaluation and post treatment follow up.

CONCLUSION

Ultrasound Bscan, in our study, was able to identify almost all orbital lesions and therefore forms an important part of initial clinical workup and for follow up of cases. Considering radiation exposure and repeated examination, cost effectiveness and time consumption, Bscan is advantageous for its high resolution and sensitivity, low cost, less time consumption and no radiation exposure . Although, imaging by CT and MRI appears more complete.

PROFORMA

1) Name

2) Age/Sex

3) O.P. / I.P. No.

4) Complaints and duration :-

H/o proptosis / enophthalmos ï onset

H/o pain/headache/vomiting

H/o defective vision/diplopia/fever

H/o tremors/weight loss/palpitation

H/otuberculosis/diabetes/hypertension/thyroid disorder/trauma/surgery

Personal h/o / tobacco/alcohol/drugs

General examination:

Thyroid / ENT examination

Local examination :

Lids ï position/movement/swelling

5) **<u>Ocular examination :-</u>**

Visual acuity with/out glasses

- Anterior segment
- Pupil

- Extraocular muscles
- IOP ï primary/differential gaze
- Fundus ï IDO

6) **<u>Proptosis</u>** ï Axial / eccentric

   Pulsation/valsalva/thrill/bruit/reducibility/compressibility/ retropulsion/orbital mass/ tenderness/ lacrimal gland enlargement / Basal exophthalmometry

7) Visual fields
8) Colour vision
9) Forced duction test
10) Retinoscopy
11) Shirmerôs test
12) Prism cover test

Relevant Investigations:

TC, DC, ESR, Blood Sugar, Mantoux test, VDRL, Xray PNS and orbit, CT Orbit-axial, coronal, contrast; Bscan (Ocular and orbital mode) with Ascan, Thyroid function tests, urine ï albumin, sugar

	Name	Age	Sex	IP/OP No.	Laterality	Symptoms	Signs	B-scan diagnosis	CT scan diagnosis
1	Priyadarshini	2½	F	47935	LE	L, R	L, M	Capillary hemangioma of lid	Capillary hemangioma of lid and anterior orbit
2	Kethansai	7	M	52783	LE	P, R, PR	P, ER, M	Rhabdomyosarcoma Orbital cellulitis	Rhabdomyosarcoma
3	Bhanu	32	F	49826	RE	PR, R	L, P, ER	Thyroid related orbitopathy	Thyroid related orbitopathy
4	Esther	38	F	45604	RE	P, PR	P, M	Lacrimal gland tumour/ lymphoma	Malignant lacrimal gland tumour
5	Selvam	22	M	404672	RE	PR, D, V	P	Optic nerve glioma	Optic nerve glioma
6	Prabakaran	50	M	51902	RE	PR, D	M, P, L, I	Pseudotumor/ lymphoma	Lymphoma
7	B/o Sundari	2 mon	F	49187	LE	PR	ER	Retrobulbar hematoma	Retrobulbar hematoma
8	Mahalakshmi	36	F	520181	BE	P, PR	P, ER, L	Thyroid related orbitopathy	Thyroid related orbitopathy

9	Nirmala	40	F	422759	BE	P, PR	P, ER, L	Throid related orbitopathy	Thyroid related orbitopathy
10	Gopi	50	M	329542	RE	P, R	P, ER	Orbital cellulitis	Orbital cellulitis
11	Rangaiah	56	M	36644	RE	P, PR, L	P, F	Widening of retroorbital fat complex	CCF
12	Narasimhalu	67	M	46270	LE	PR, V	P, M, ER	IOID	IOID
13	Tamilvannan	14	M	18120	RE	L, M	M	Dermoid cyst	Dermoid cyst
14	Mariyappan	55	M	24844	LE	P, V	PR, ER, I	Infiltrative mass in inferior orbit	Ca maxillary antrum invading orbit
15	Shabila	25	F	430556	LE	PR	M, P	Lacrimal gland tumor	Malignant lacrimal gland tumor
16	Muthiah	64	M	52249	RE	P, V	PR, ER	Mass lesion/ orbital cellulitis	Mucormycosis of orbit
17	Saroja	42	F	520181	BE	P, PR	P, EK, L	Thyroid related orbitopathy	Thyroid related orbitopathy

18	Thanthayee	65	F	461394	RE	L, V	L, M	Pseudotumor/ lymphoma	Lymphoma of arbit
19	Akshaya	8	F	409958	LE	M	M	Dermoid cyst	Dermoid cyst
20	Rajesh	45	M	409887	RE	P	P, ER	Orbital cellulitis	Orbital cellulitis
21	Kothandammal	31	F	16901	LE	D, PR	PR, ER	IOID	IOID
22	Janakiraman	10	M	10622	RE	M	M	Dermoid cyst	Dermoid cyst
23	Zabira Begum	46	F	411225	Lt	P, PR	PR, ER	Lacrimalgland tumour/ IOID	IOID
24	Pothamma	41	F	17120	Lt	M, L	M	Lacrimal gland tumor	Lacrimal gland tumor
25	Sampath	36	M	36792		L, V	L, M	Pseudotumor	Lymphoma
26	Dhanam	6	F	51902	RE	R, L	M, E	Capillary hemangioma of lid	Capillary hemangioma of anterior orbit
27	Chandra	28	F	57160	LE	P, V	ER, P, EK	Orbital cellulitis	Orbital cellulitis
28	Jyothi	38	F	545411	RE	P, PR	PR, ER	TRO	TRO
29	Vijaykrishnan	2	M	47018	LE	M, PR	PR, M	Rhabdomyosarcoma	Rhabdomyosarcoma

30	Ravi	40	M	36792	BE	PR	P, ER	TRO	TRO
31	Nasreen	24	F	370513	LE	PR	P, ER	Fibrousdysplasia	Fibrous dysplasia of frontal bone

32	Janani	36	F	17120	RE	PR, D	P, F	Optic nerve sheath meningioma	Optic nerve sheath meningioma
33	Baby	14	F	41225	LE	L, M, V	P,L,ER,M, E	Neurofibroma of lid	Neurofibroma invading anterior orbit
34	Sujatha	6 mon	F	412265	LE	R, L	L,M	Capillary hemangioma	Capillary hemangioma
35	Ponnusamy	55	M	408826	RE	P, V	PQ, ER, I	? Orbital cellulitis ? mucormycosis	Mucormycosis of orbit
36	Palani	48	M	470513	LE	P, V	ER, EK	Orbital cellulitis	Orbital cellulitis
37	Lingammal	51	F	19184	RE	P, PR	PR, ER, M	Pseudotumour lymphoma	IOID
38	Bharath	1	M	36644	RE	PR	P	Retrobulbar hematoma	Retrobulbar hematoma
39	Veerapandi	25	M	47844	LE	PR, V	P,F	Optic nerve glioma	Optic nerve glioma with intracranial extension
40	Santhan	50	M	451902	RE	L, V	L,M	Lymphoma	Lymphoma

41	Shankar	60	M	411191	LE	PR	P,ER	TRO	TRO
42	Rajamanickam	59	M	367692	RE	P, V	PR,M,F, ER	Infiltrative mass lesion	Ca. maxillary sinus
43	Ramesh	30	M	460741	RE	P, PR	PR,M	IOID	IOID
44	Roja	42	F	58621	BE	P, PR	PR, M	IOID	IOID
45	Kamala	28	F	452751	LE	V,PR	P,ER	Normal orbit	TRO
46	Manavalan	55	M	409781	RE	P,M	M,ER,I	Carcinoma of lid extending extraconally	Squamorus cell carcinoma of lid invading orbit
47	Sudha	27	F	416282	LE	M	M	Dermoid cyst	Dermoid cyst
48	Masanam	46	M	466901	BE	P,PR	M,PR	Normal orbit	IOID
49	Kannadasan	3 mon	M	46270	LE	L,R	P,M	Hemangioma of lid	Capillary hemangioma with dilated ophthalmic artery
50	Durairaj	36	M	52081	RE	V,L	ER,L	Orbital congestion	CCF (Superior ophthalmic vein enlarged)

51	Mani Iyer	40	M	370513	LE	PR	P,ER	Normal orbit	TRO
52	William	58	M	58621	RE	PR	P	Cavernous hemangioma	Cavernous hemangioma
53	Vaishnavi	26	F	416198	RE	PR	P,ER	Fibrous dysplasia	Fibrous dysplasia
54	Dhanyashree	32	F	470181	LE	PR	P	Cavernoushemangioma	Cavernoushemangioma
55	Vasantha	36	F	463538	LE	PR,P	PR	Mucocele of frontal sinus	Frontal sinus mucocele
56	Premalatha	2	F	410439	LE	R,L	M,E	Lymphangioma	Lymphangioma
57	Shanmugam	30	M	57160	LE	V,PR	ER,P	Optic nerve glioma	Optic nerve glioma
58	Manavalan	36	M	409781	RE	L,M,V	P,L,ER	Neurofibroma of lid	Neurofibroma of lid/ant orbit/sphenoid wing dysplasia
59	Raju	30	M	17120	RE	PR,D	M,P,L	Lacrimal gland tumour	Benign lacrimal gland tumor
60	Dhanush	2	M	22641	LE	L,R	P,M	Lymphangioma	Lymphangioma/ hemangioma

61	Arunachalam	46	M	432451	RE	P,PR	PR,ER	Normal orbit	IOID
62	Maheswari	30	F	52249	RE	PR	P,M	Normal	Orbital varices
63	Sadayappan	50	M	46958	LE	P,V	P,ER,F	Orbital cellulitis	Orbital cellulitis

64	Raman	52	M	47093	RE	P,M	M,ER,I	Carcinoma of lid extending extraconally	Squamous cell ca of lid
65	Kothandam	40	M	416198	LE	PR	P	Cavernous hemangioma	Cavernous hemangioma
66	Dhanalakshmi	15	F	32018	RE	R,L	M,E	Capillary hemangioma of lid	Capillary hemangioma of lid
67	Kesavan	7	M	42144	LE	P	PR	Orbital cysticercosis	Orbital cysticercosis
68	Mannuswamy	68	M	413530	RE	P,V	PR,M,F	Infiltrative mass lesion in orbit	Ca. ethmoid sinus
69	Lakshmi	35	F	416439	RE	P,PR	PR,EK,M	Normal orbit	IOID
70	Srinivasan	42	M	54541	LE	P,PR	PR,ER,M	IOID	IOID

Index to Master Chart

LE	-	Left eye
RE	-	Right eye
IOID	-	Idiopathic orbital inflammatory disease
Ca	-	Carcinoma
CCF	-	Carotid cavernous fistula
TRO	-	Thyroid related orbitopathy
M	-	Male
F	-	Female

Symptoms	Mon	-	Months
	P	-	Pain
	L	-	lid swelling
	V	-	Defective vision
	D	-	Diplopia
	R	-	Redness
	PR	-	Protrusion or displacement of eyeball
	M	-	Mass visible
Signs	I	-	Infraorbital anesthesia
	E	-	Enophthalmos
	ER	-	Extraocular muscle restriction
	P	-	Proptosis
	L	-	Lid lag, lid retraction, ptosis

EK - Exposure keratopathy

M - Mass palpable
F - Fundus changes

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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No: 044 25305301
Fax: 044 25363970

CERTIFICATE OF APPROVAL

To
Dr. A. Sudhamathy
PG in MS Ophthalmology
Madras Medical College, Chennai -3

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "A study of Ultrasound B Scan findings in proptosis and correlation with CT Scan " No. 25082011

The following members of Ethics Committee were present in the meeting held on 16.08.2011 conducted at Madras Medical College, Chennai -3.

1. Prof. S.K. Rajan. MD	-- Chairperson
2. Dr. V. Kanagasabai MD Dean, Madras Medical College, Chennai -3	-- Deputy Chairman
3. Pro. A. Sundaram MD Vice Principal, Madras Medical College, Ch -3	-- Member Secretary
4. Prof. R. Sathianathan MD	-- Member
5. Prof. R. Nandhini MD Director, Institute of Pharmacology ,MMC, Ch-3	-- Member
6. Prof. C. Rajendiran, MD Director , Inst. Of Internal Medicine, MMC, Ch-3	-- Member
7. . Thiru. A. Ulaganathan Administrative Officer, MMC, Ch-3	--- Layperson
8 . Thiru. S. Govindsamy. BA BL	-- Lawyer
9. Tmt. Arnold soulina MA	-- Social Scientist

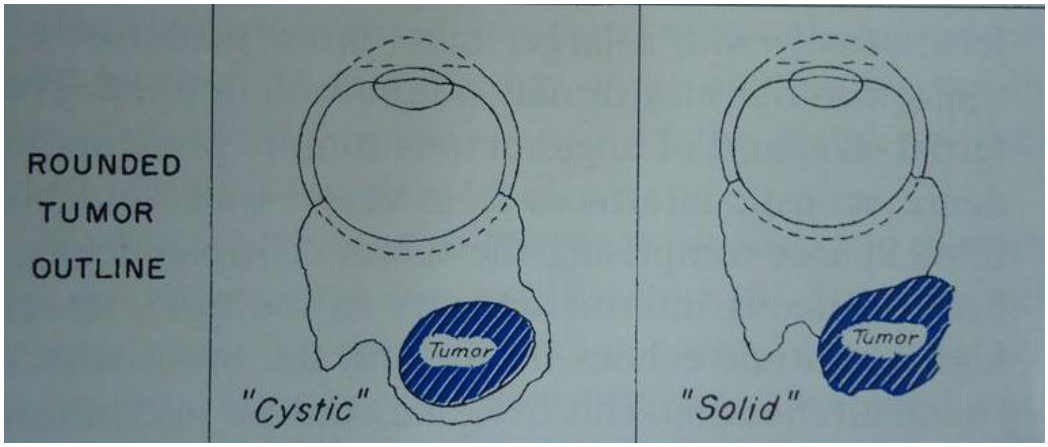
We approval the proposal to be conducted in its presented form.

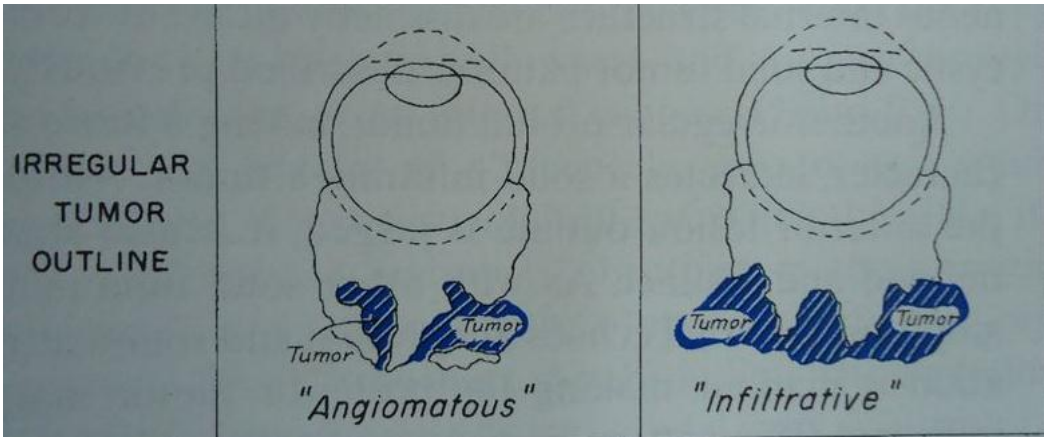
Sd/ chairman & Other Members

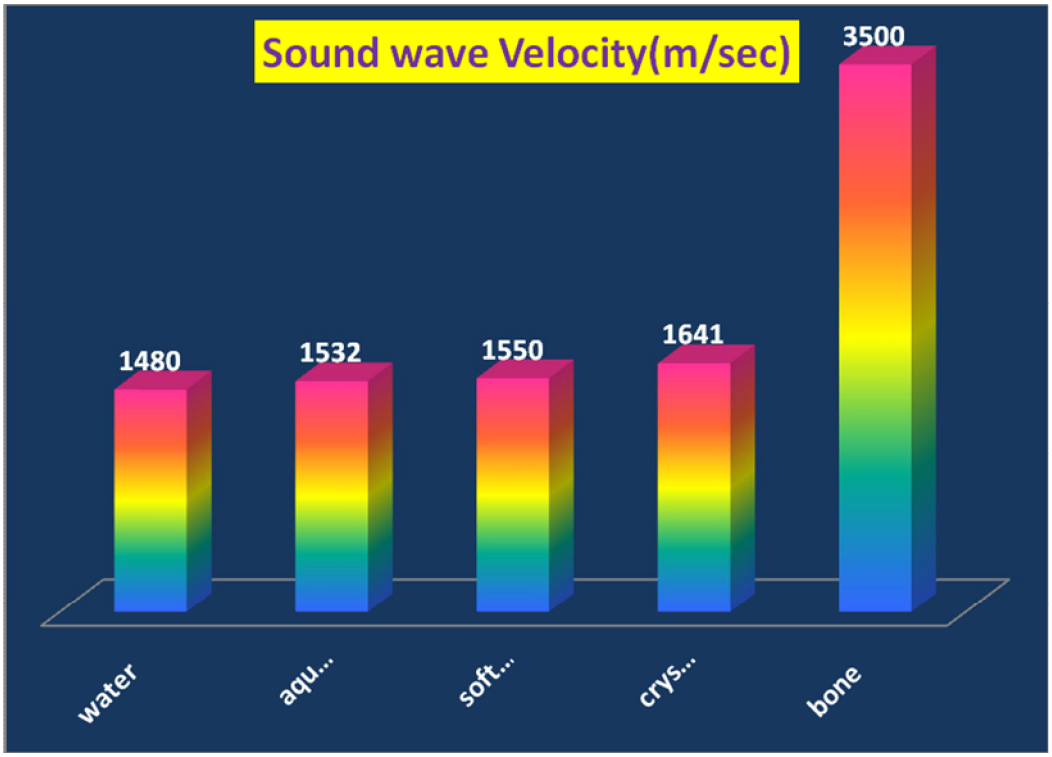
The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

ULTRASOUND CLASSIFICATION OF ORBITAL TUMOURS



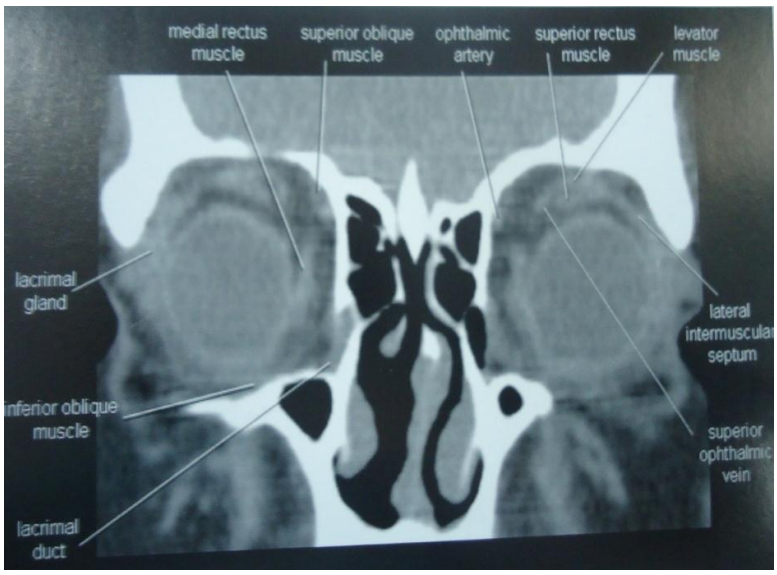



Sound wave Velocity(m/sec)
1480
1532
1550
1641
3500
water
aqu...
soft...
crys...
bone

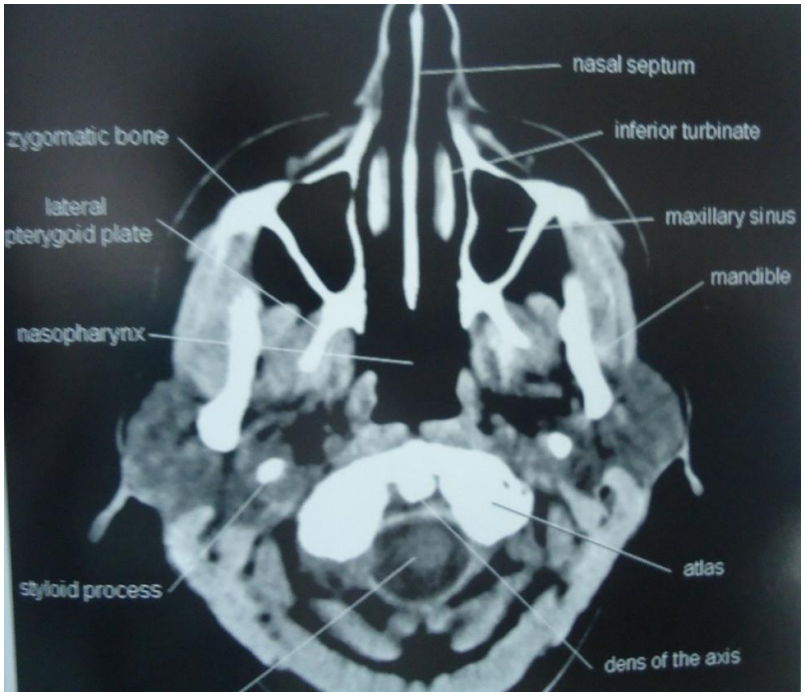
OTI Scanner - 1000 UNIT

Probe with marker

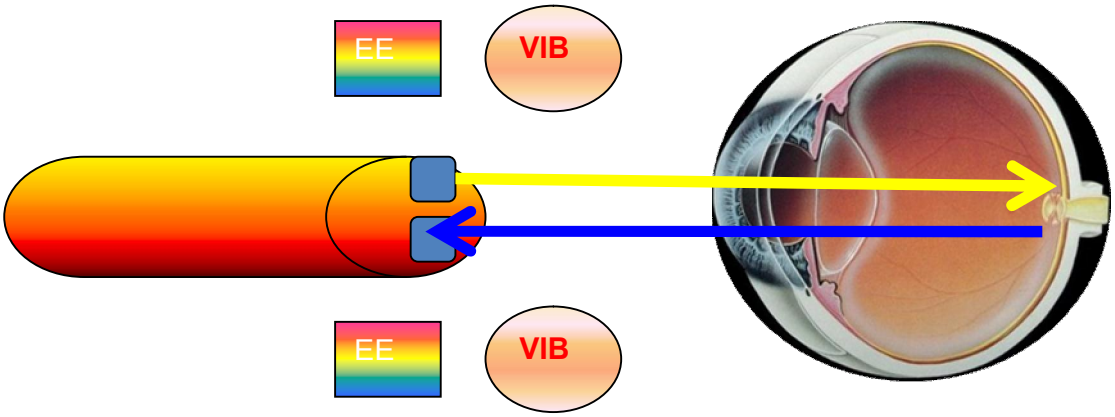
CT CORONAL VIEW



CT AXIAL VIEW



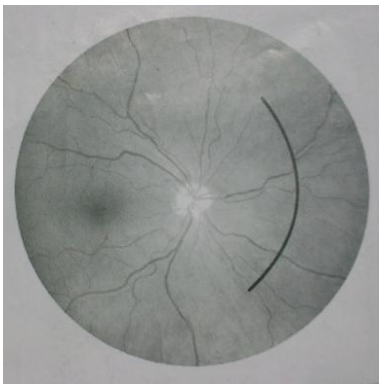
PIEZO ELECTRIC CRYSTAL-TRANSDUCER



EE-Electrical energy

Vib-Mechanical Vibration

TRANSVERSE



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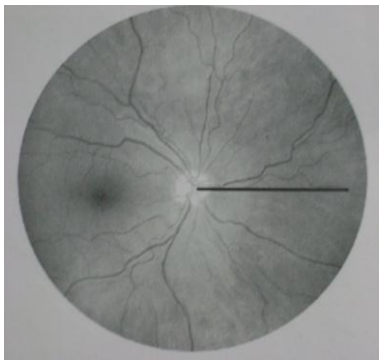

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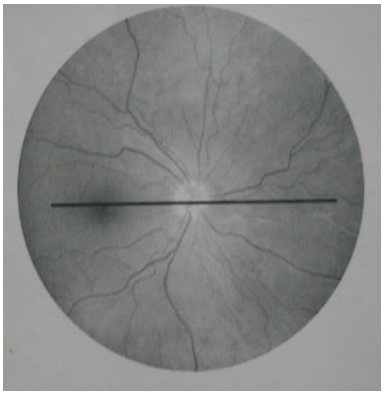
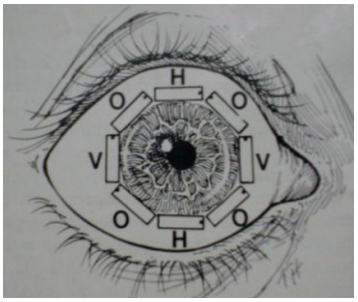


PROBE POSITIONING

TRANSVERSE



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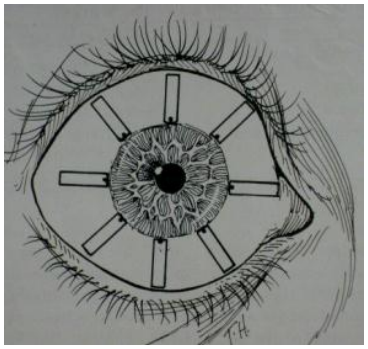

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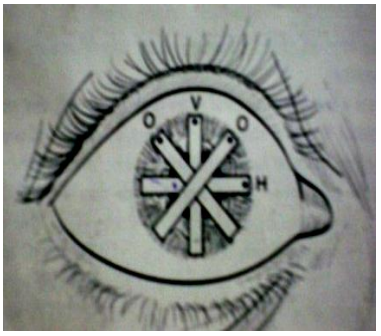

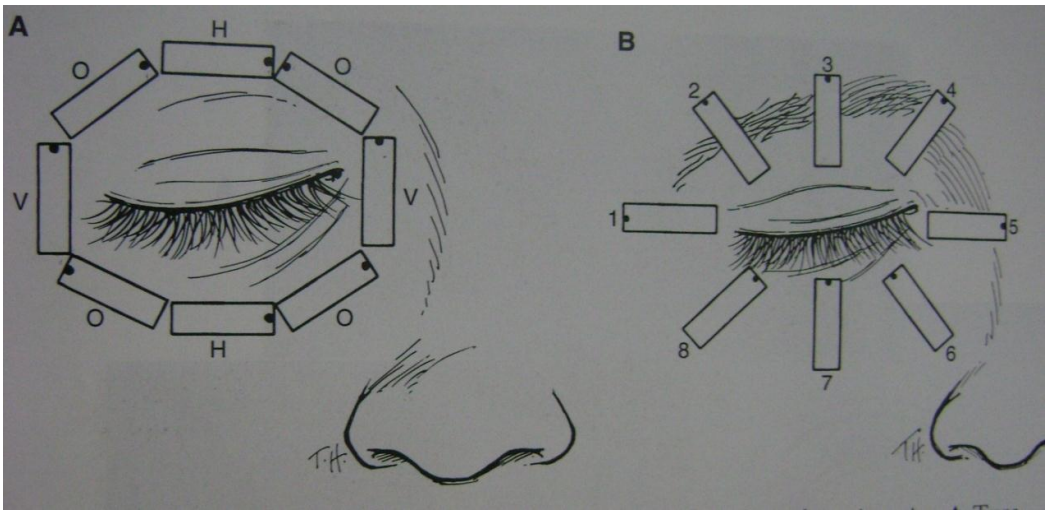

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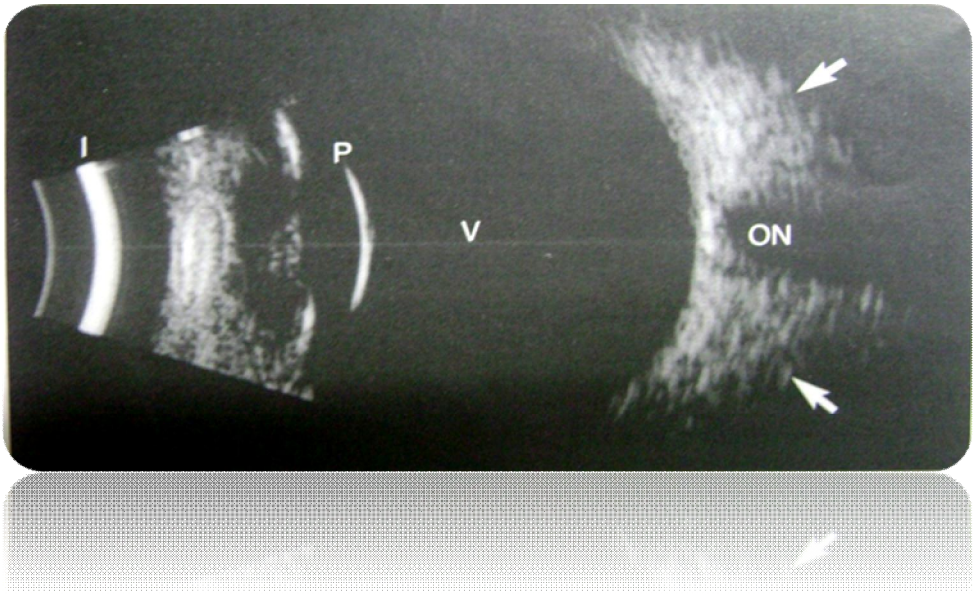
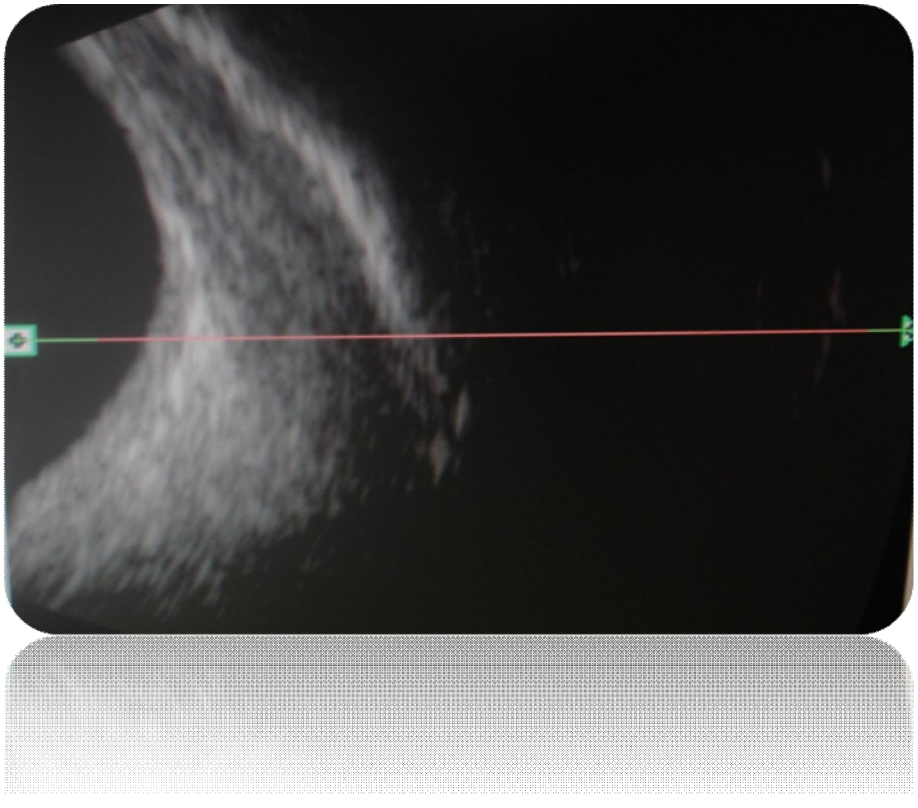


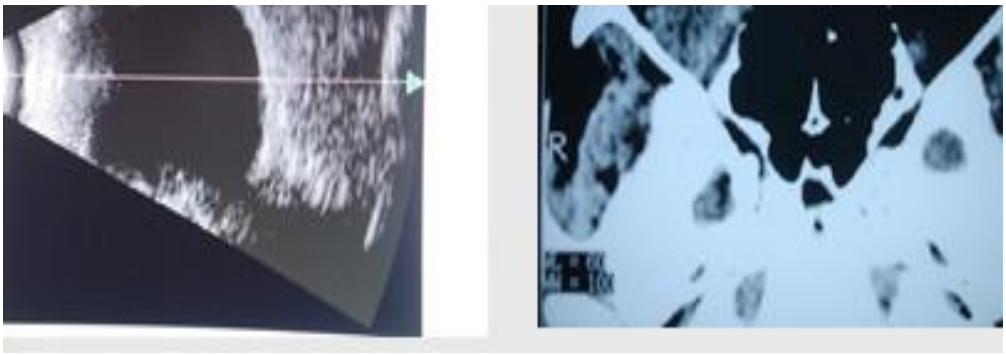
EXTRA OCULAR MUSCLE THICKENING

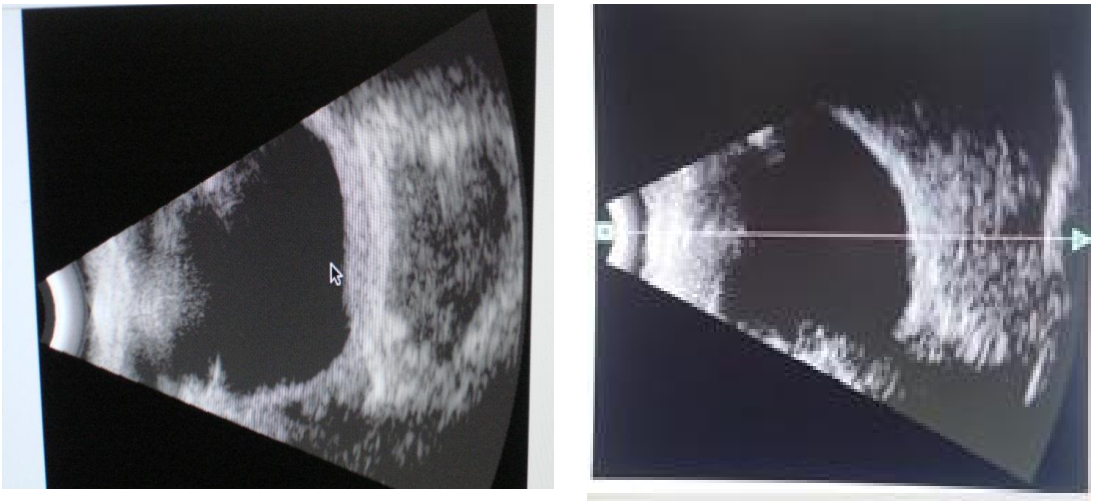


B SCAN & CT PICTURE OF PSEUDO TUMOUR

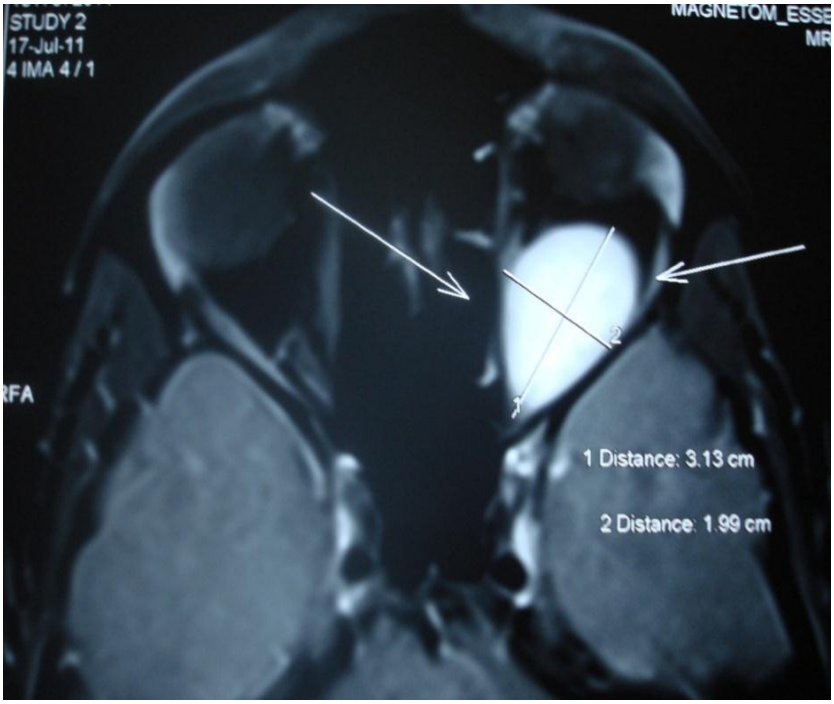
Case No.12

REGRESSION OF PSEUDO TUMOUR Case No.43

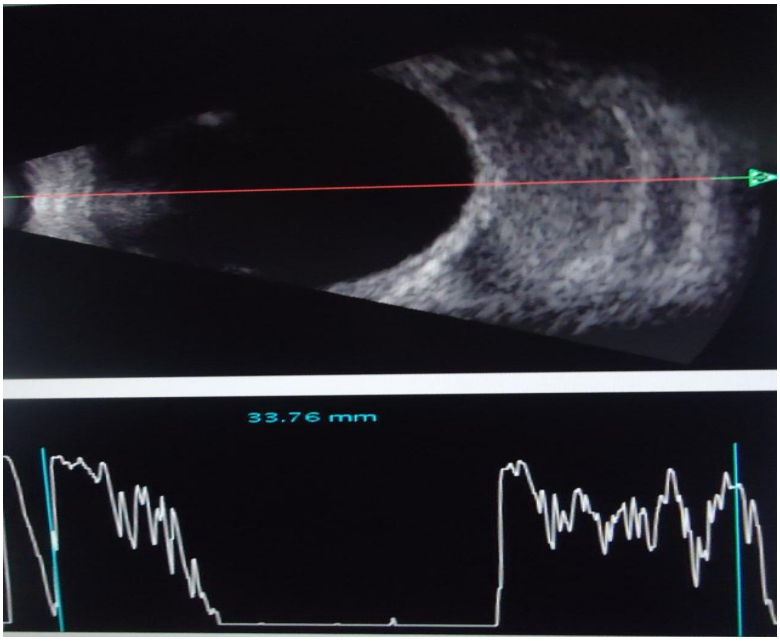




CT PICTURE OF OPTIC NERVE GLIOMA Case No.57



B SCAN PICTURE OF OPTIC NERVE GLIOMA Case No.57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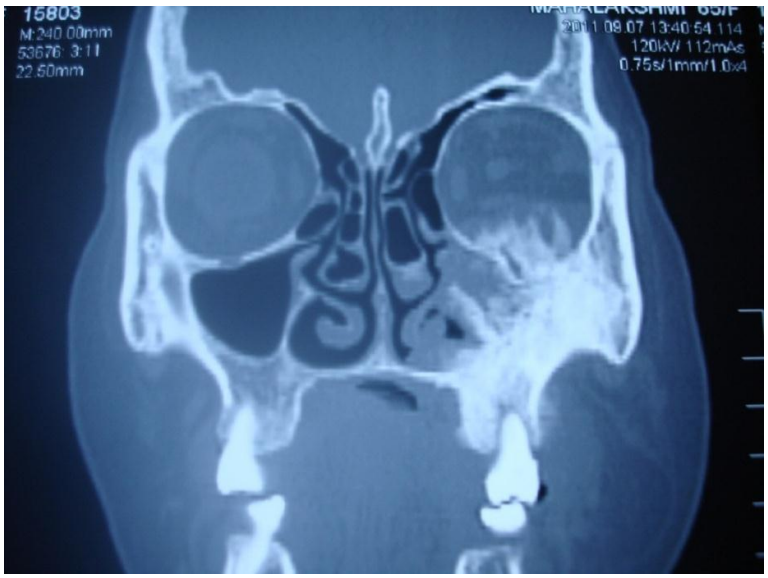
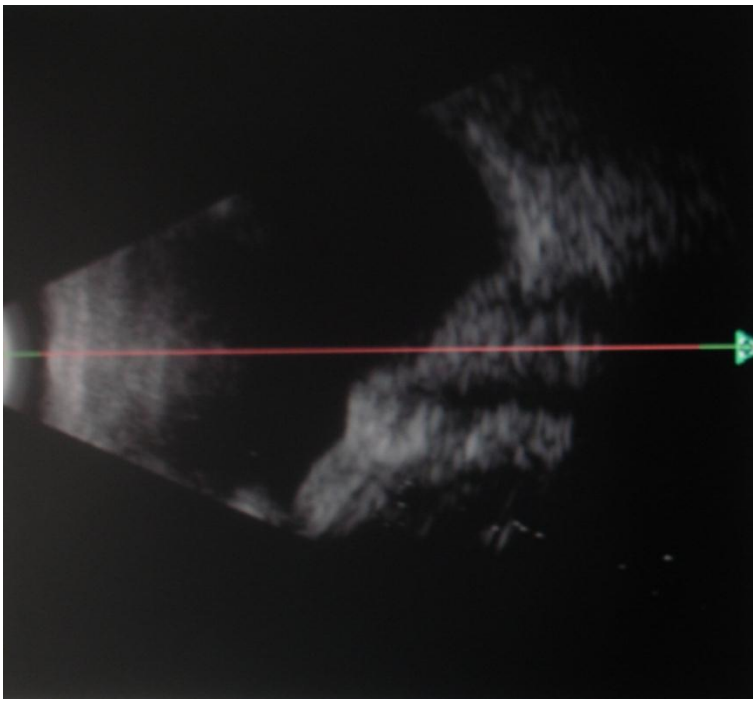
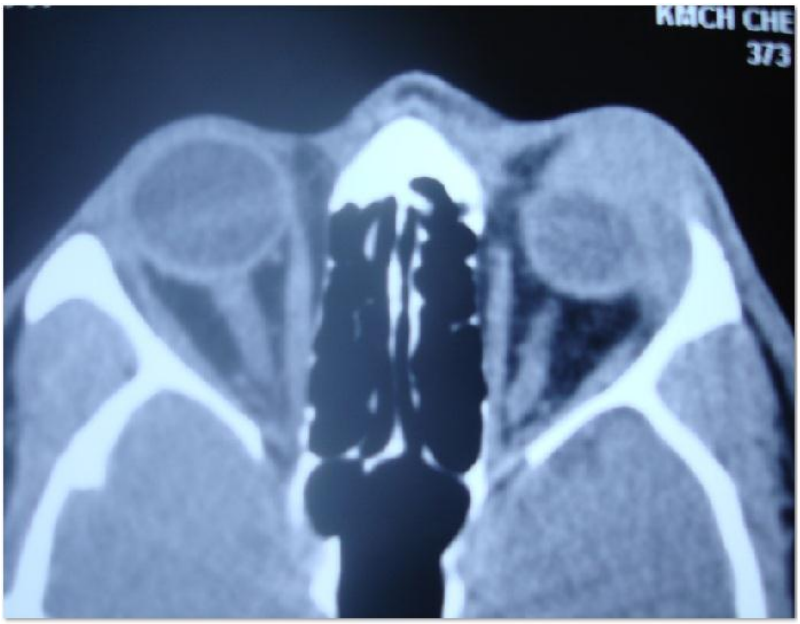
CT PICTURE OF MAXILLARY CARCINOMA INVADING ORBIT Case No.42



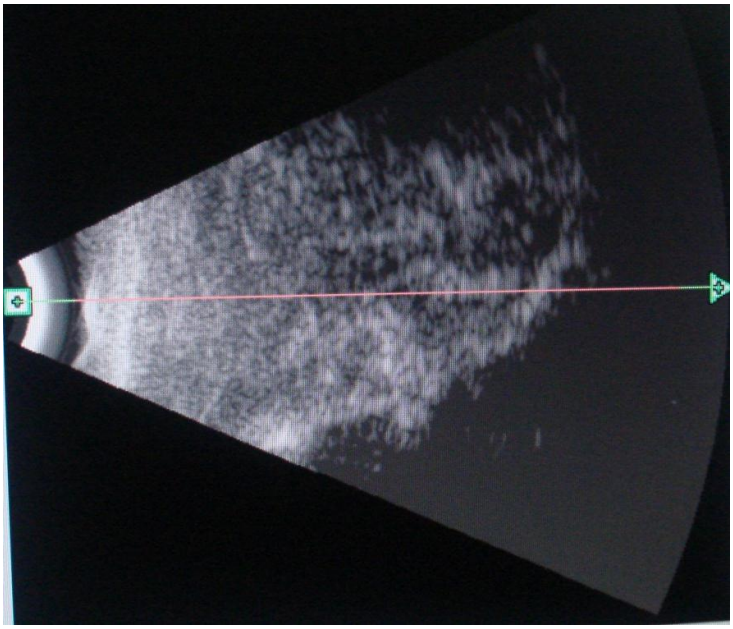
B SCAN PICTURE OF MAXILLARY CARCINOMA INDENTING GLOBE Case No.42



CT PICTURE OF LYMPHOMA OF ORBIT Case No.40

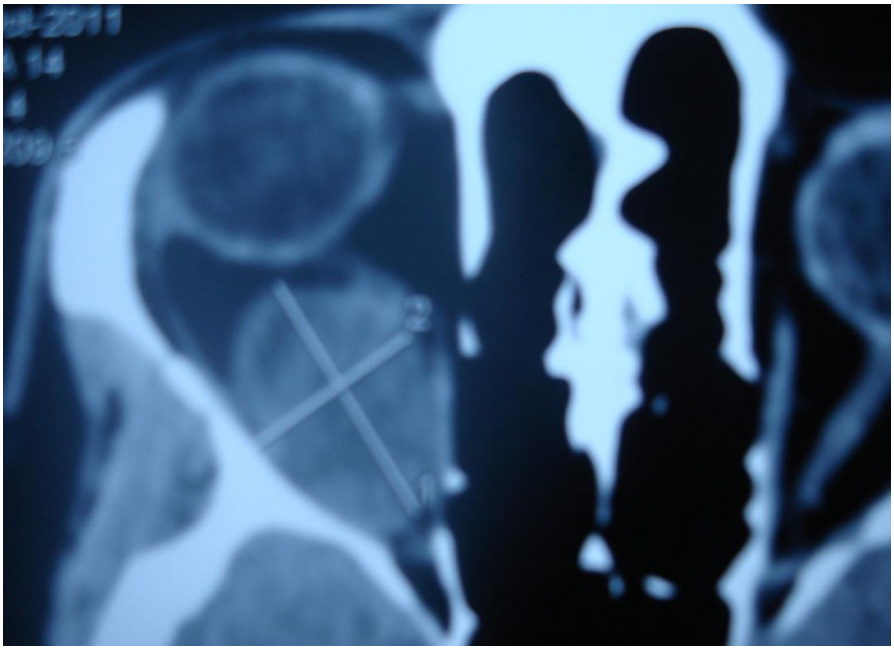


B SCAN OF LYMPHOMA Case No.40



CT PICTURE OF CAVERNOUS HEMANGIOMA

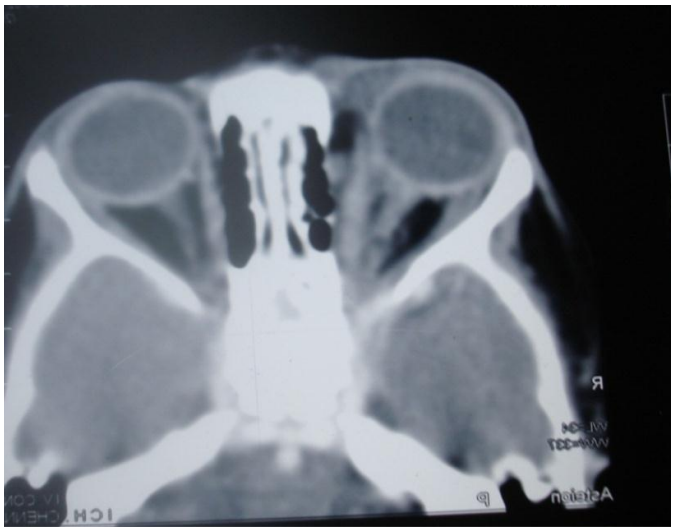
Case No.54



B SCAN PICTURE OF CAVERNOUS HEMANGIOMA

Case No.54

CT PICTURE OF LYMPHANGIOMA case No.56



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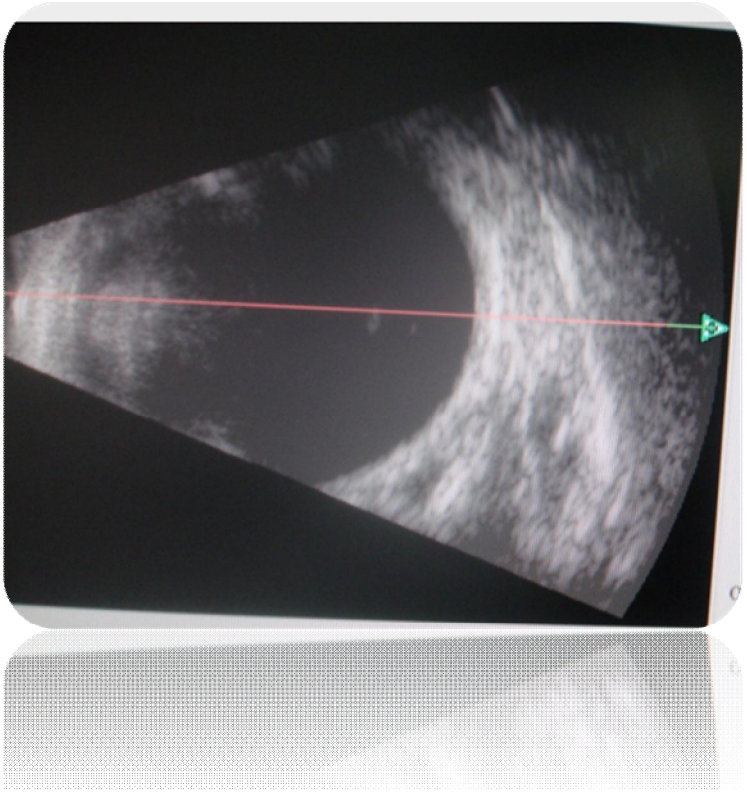
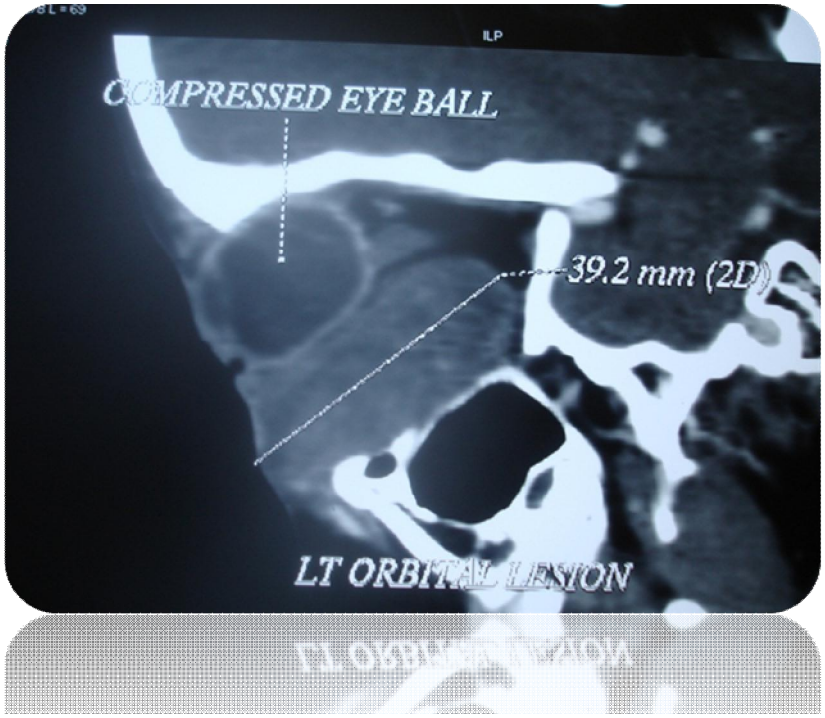
case No.56

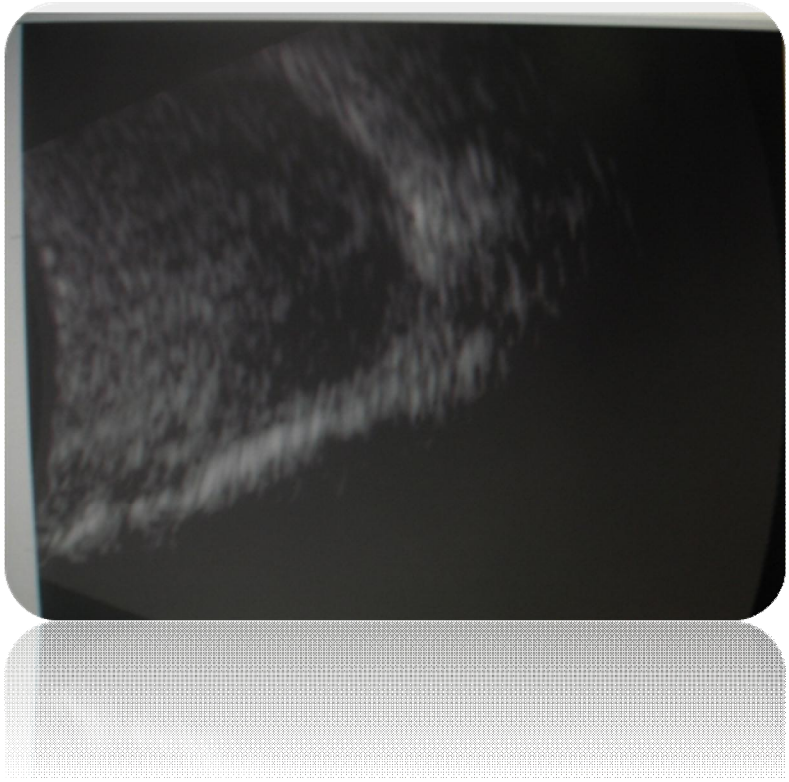


CT PICTURE OF RHABDOMYOSARCOMA Case No.2



B SCAN PICTRUE OF RHABDOMYOSARCOMA

Case No.2

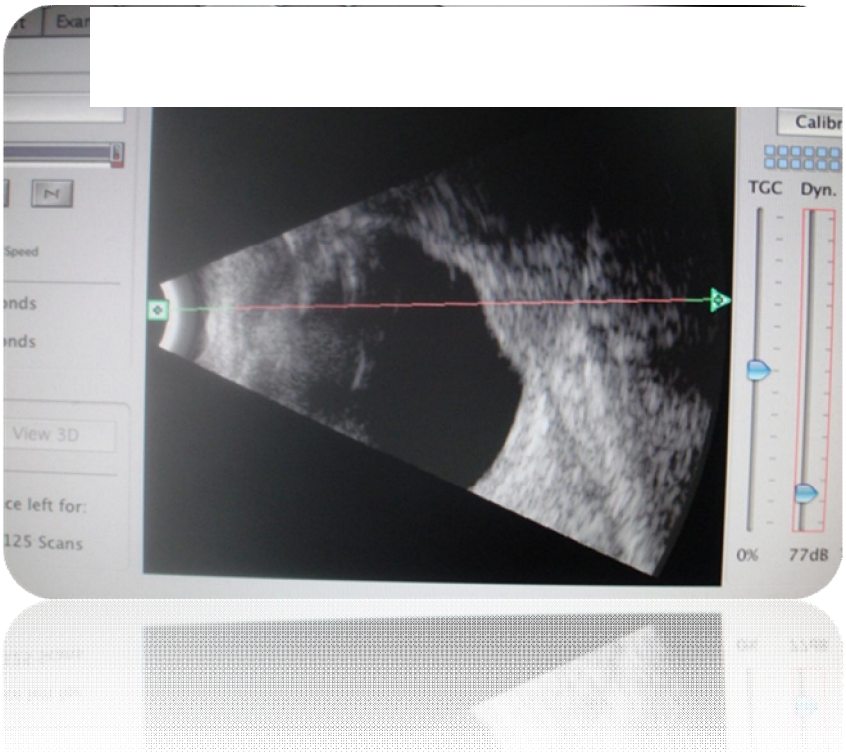


CT PICTURE OF SQUAMOUS CELL CARCINOMA OF LID

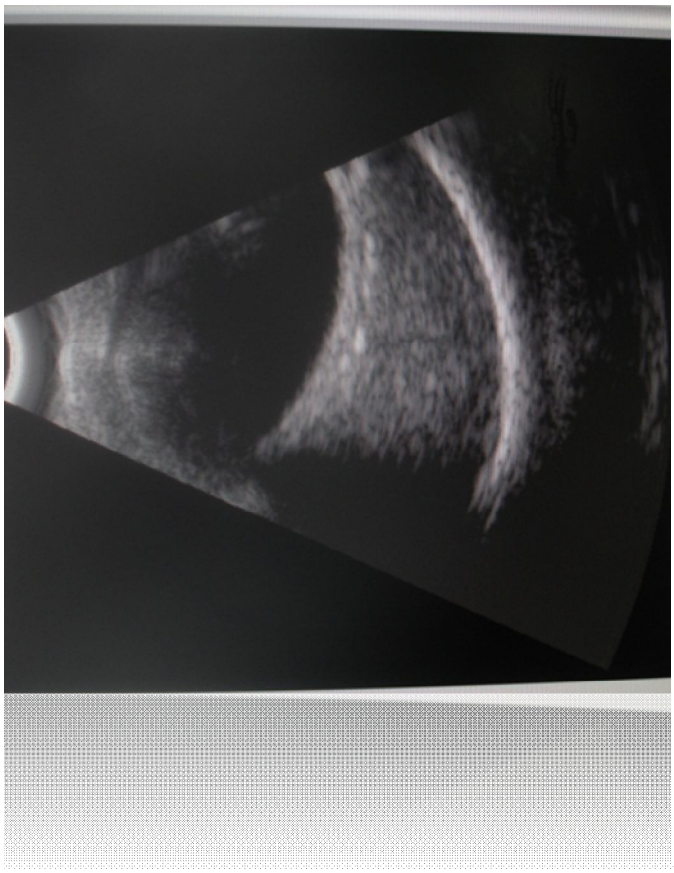
Case No.42

B

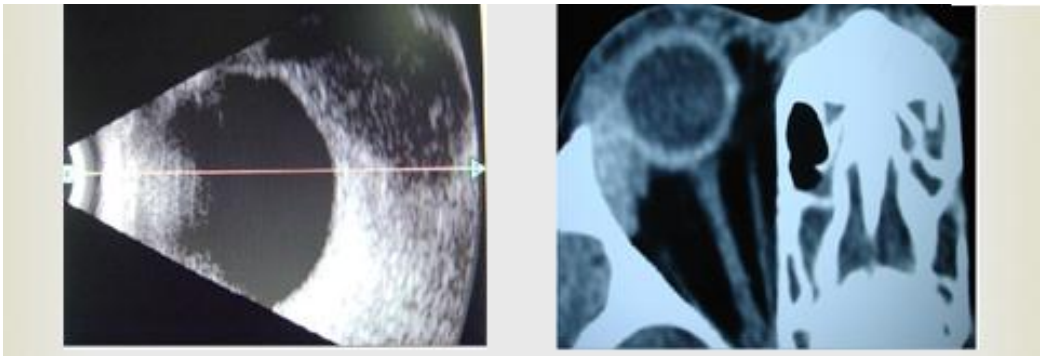
SCAN PICTURE OF SQUAMOUS CELL CARCINOMA OF LID INDENTING GLOBE Case No.42


Speed
View 3D
ce left for:
125 Scans
TGC
Dyn.
0%
77dB

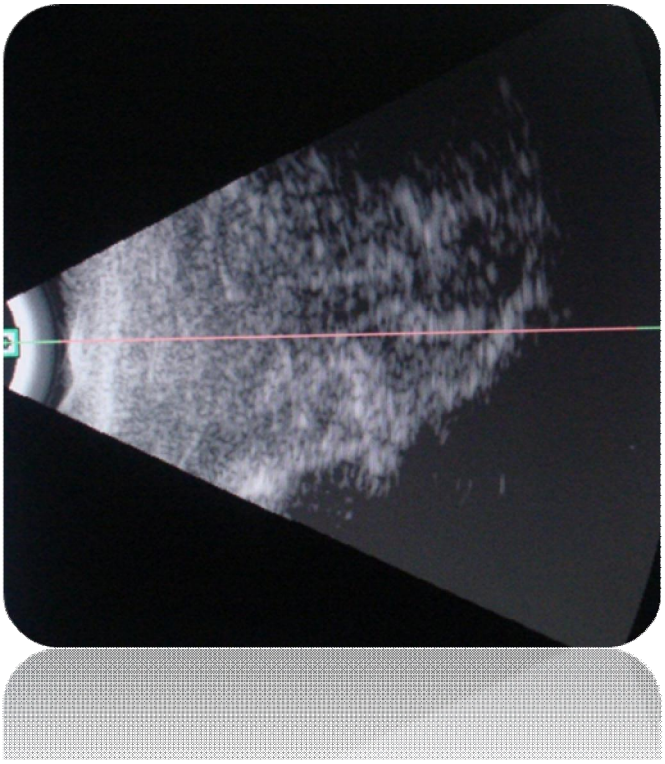
B SCAN PICTURE OF RETROBULBAR HEMATOMA Case No.38



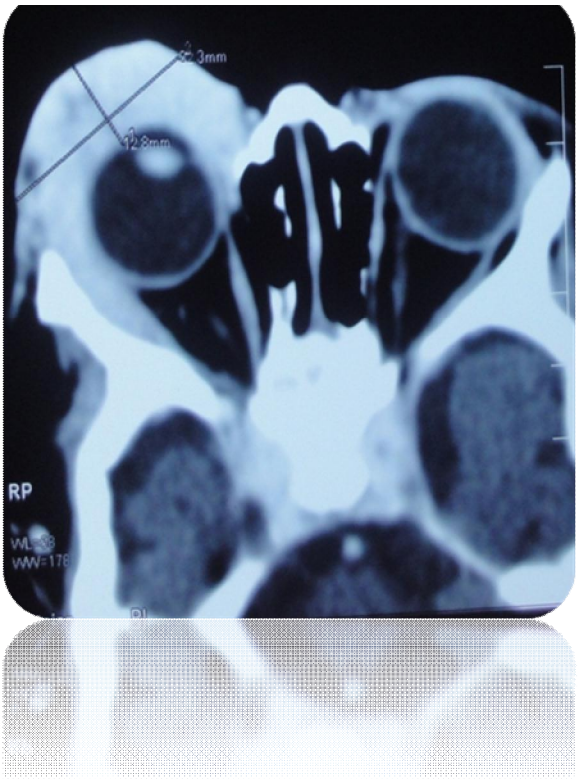
BENIGN LACRIMAL GLAND TUMOUR Case No.59



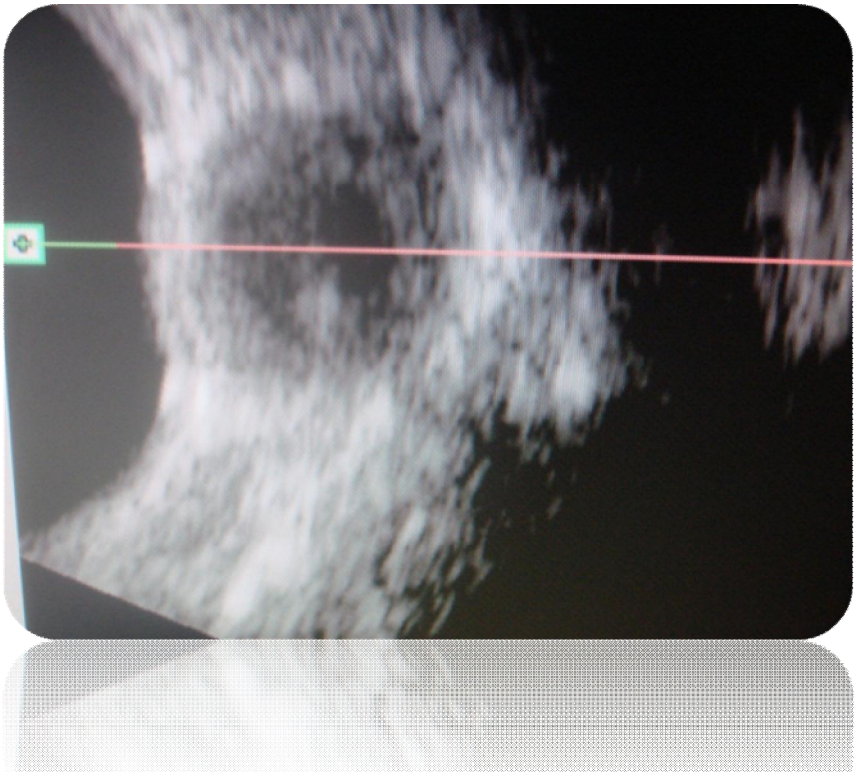
B SCAN PICTURE OF CAPILLARY HEMANGIOMA OF LID
Case No.60



CT PICTURE OF CAPILLARY HEMANGIOMA OF LID
Case No.60



B SCAN PICTURE OF ORBITAL CYSTICERCOSIS Case No.67



CT SCAN PICTURE OF ORBITAL CYSTICERCOSIS

Case No.67